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ABSTRACT

Twenty-one general construction units are presented in this teacher's guide. The units are organized as follow: concrete finishing-two units (e.g., site preparation, pouring and finishing); plumbing-five units (e.g., pipe joints, angles, and flow; fixtures and valves); electrical wiring-five units (e.g., wiring procedures, planning a layout); painting-four units (e.g., wall preparation and prime coating; finish coating); and masonry and bricklaying-five units (e.g., mortar preparation and application; masonry walls). Each instructional unit generally contains eight components: performance objectives; an outline of minimum instructor and student activities to accomplish unit objectives; information sheets presenting basic unit content; transparency masters; job sheets which outline skills to be achieved; student assignment sheets related to the unit information sheets (answer sheets are provided); and objective tests with answer sheets. (CT)

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GENERAL CONSTRUCTION TRADES

Volume 2 TEACHER'S GUIDE

MATERIALS DEVELOPED AND DISTRIBUTED BY
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Secondary and Higher Education
East Texas State University
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IN COOPERATION WITH
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Occupational Education and Technology
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FIRST EDITION

1978

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FOREWORD

The Occupational Curriculum Laboratory at East Texas State University is striving to provide needed curriculum materials to vocational instructors within the state. Because of the number of programs within the General Construction Trades teaching areas, we have chosen to develop and disseminate this publication at this time.

The purpose of this publication is to assist instructors in improving instruction. As these materials are used, it is hoped that student performance will improve and that students will be better prepared to assume a role in a construction occupation.

Instructional materials in this publication are written in terms of student performance using measurable objectives. This is an innovative approach to teaching that accents and augments the teaching-learning process. Criterion-reference evaluation instruments are provided for a uniform measurement of student progress. In addition to evaluating recall information, teachers are encouraged to evaluate the other areas, including process and product, as indicated at the end of each instructional unit.

Every effort has been made to make this publication basic, readable, and, by all means, usable. Three vital areas of instruction (motivation, personalization, and localization) are not included in this publication and should be capitalized on by the instructor. Only then will this publication really become a vital part of the teaching-learning process.

USE OF THE INSTRUCTIONAL UNITS

The General Construction Trades instructional units cover certain instructional areas in the shop program. Each instructional unit includes most or all of the basic components of a unit of instruction: performance objectives, suggested activities, information sheets, assignment sheets, job sheets, transparency masters, unit tests, and answers to unit tests. Units are planned for more than one classroom period of instruction.

Careful study of each instructional unit will enable the teacher to determine:

- A. The amount of material that can be covered in each class period
- B. The skills that must be demonstrated
- C. The supplies and equipment needed for skill performance
- D. The amount of classroom time needed for teacher demonstration and student practice
- E. Supplementary materials that must be ordered
- F. Any resource personnel who must be contacted

The specific components of an instruction unit perform the following functions.

OBJECTIVES

Each unit of instruction is based on performance objectives. These objectives specify the exact behaviors the students will be exhibiting, thus providing students with a sense of direction.

Performance objectives are stated in two forms. The unit objectives state the materials to be covered in the unit of instruction and how the student will handle the material. Specific objectives state the types of performance the student will be doing to satisfy the unit objective.

A classroom discussion should follow immediately after the students read the objectives so that any questions concerning the performances expected of the student can be answered.

SUGGESTED ACTIVITIES

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives.

Instructor--Duties of the instructor will vary from unit to unit, but the following are minimum activities for the instructor:

1. Provide students with objectives, information, assignment and/or job sheets
2. Discuss objectives and information sheets
3. Make transparencies
4. Demonstrate procedures outlined on job sheets (when included)
5. Give test
6. Review students' weak areas pointed out by the test

Any additional instructional activities and teaching methods to aid students in accomplishing the objectives are strongly encouraged.

Student--Student activities are listed to help the student achieve the objectives of the unit

INFORMATION UNIT

Information sheets provide content essential for meeting the cognitive requirements of the unit. These sheets provide an excellent guide for presenting knowledges necessary to develop the skills specified in the unit objective.

Students should read the information sheets before the information is discussed in class. Students are encouraged to make any additional notes on the information sheets to help them in their learning process.

TRANSPARENCY MASTER

Transparency masters provide information in a special way. Transparencies may present new information, or they may reinforce information presented in the information sheets. They are particularly effective when identification is necessary.

Make the transparencies from themasters and place them in your notebook ready for immediate use.

Copies of transparency masters can be made and used as student handouts to supplement the material contained in the information sheet.

JOB SHEETS

Job sheets are an integral part of each unit of instruction. The instructor should be able to demonstrate the skills outlined in the job sheets. Procedures specified in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress in performing the skill. Job sheets provide a ready outline to students and furnish to potential employers a picture of the types of skills being taught. Job sheets may be used as an individual or teamwork project.

ASSIGNMENT SHEETS

Assignment sheets give direction to study and furnish activities which provide application of the knowledges contained in the information sheet. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided for checking student progress.

UNIT TEST

Unit test questions have been constructed to measure student achievement of each specific objective listed on the objectives sheet. Individual test items may be pulled out and used as an objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the terminal objective.

ANSWERS TO UNIT TEST

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

PERSONALIZING AND LOCALIZING INSTRUCTIONAL UNITS

Carefully review the instructional units before using the unit in the classroom. In reviewing the units, you may find it necessary to localize and personalize the units based upon the needs of your students.

Some of the ways of supplementing units are the use of audio-visual, attention-getters, field trips, resource personnel, games and simulations, case studies, peer teaching, role playing, and personal experiences of both the teacher and students.

Various methods may be used in localizing a unit of instruction. You may wish to apply units of instruction to the local community, add additional materials from newspapers and magazines, invite local resource people, and arrange field trips.

In personalizing a unit of instruction, you may want to make the course content relevant to home and/or work situations. You may wish to involve students in the planning of the unit by using their own personal experiences. Having students involved in the teaching of some of the materials is sometimes an effective example of peer teaching.

Remember that as an instructor, you may wish to add any objectives to the units of instruction based on the individual needs of the student. If this procedure is followed, you must add any assignment or job sheets as deemed necessary and construct a corresponding unit test item.

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UNIT I

CONCRETE TOOLS AND MATERIALS

UNIT OBJECTIVE

After completing this unit, the student will be able to identify concrete tools and materials. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match the terms and definitions associated with concrete tools and materials
2. Identify six concrete working tools
3. Identify five concrete finishing tools
4. Demonstrate the ability to identify eleven concrete tools on display

UNIT I
CONCRETE TOOLS AND MATERIALS

SUGGESTED ACTIVITIES

I. Instructor:

- A. Discuss unit objective
- B. Provide students with information and assignment sheets
- C. Prepare transparencies and lesson plans
- D. Prepare display of eleven concrete working tools listed in Parts II and III of information sheet
- E. Discuss information and assignment sheet
- F. Give test
- G. Review problem areas identified by test

II. Student:

- A. Discuss questions on unit objective
- B. Read and discuss information and assignment sheets
- C. Complete assignment sheet
- D. Take unit test
- E. Discuss test questions missed

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
 - 1. TM-1--Concrete Working Tools
 - 2. TM-2--Concrete Finishing Tools
 - 3. TM-3--Portable Concrete Mixer

- D. Assignment sheet--Identify Concrete Tools
- E. Unit test
- F. Answers to unit test

II. References:

- A. Feirer, John L. and Hutchings, Gilbert R. Carpentry and Building Construction. Peoria, Illinois: Chas. A. Bennett Co., Inc. 1976.
- B. Landers, Jack M. Construction (Materials, Methods, Careers). South Holland, Illinois: Goodhearth-Wilcox Co., Inc. 1976.

UNIT I

CONCRETE TOOLS AND MATERIALS

INFORMATION SHEET

I. Terms and definitions

- A. Cement--A bonding material that hardens when mixed with water
- B. Concrete--A mixture of cement, sand, gravel and water in varying amounts according to its use
- C. Fill sand--Sand used under concrete slabs to bring the ground level to the height desired
- D. Reinforcement bar (Rebar)--Steel rod ranging in size from 1/4 to 1 1/2 inches and used to strengthen concrete
- E. Tie wire--Wire used to tie rebar together
- F. Reinforcing mesh (Remesh)--Crisscrossed wire (usually 10-gauge forming six inch squares) used to strengthen concrete
- G. Screed--A straight piece of material such as a 2 x 4 board used to level wet concrete
- H. Form--Holds concrete in place until it hardens or "sets up"
- I. Stakes--Pieces of wood used to hold forms in place
- J. Duplex nail--A nail with a double head used to make forms
- K. Knee boards--Boards a worker stands or kneels on while working on wet concrete

II. Concrete working tools (Transparency #1)

- A. Contractors wheelbarrow--Used to move concrete or fill sand and usually 3 1/2 to 5 1/2 cubic feet capacity
- B. Shovel--Used to mix concrete
- C. Knee pads--Leather or heavy rubber pads used to protect the knees while finishing concrete

- D. Concrete placer--A wide-bladed device with a handle used to spread wet concrete
- E. Jitterbug--A tool used to tamp the gravel below the surface of wet concrete to allow a smooth finish
- F. Bull float--Used to surface and remove excess water after jitterbugging wet concrete

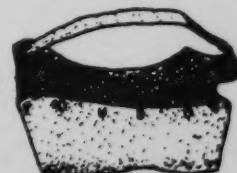
III. Concrete finishing tools (Transparency #2)

- A. Trowel--A tool used for final finishing of concrete.
(NOTE: Comes in various sizes.)
- B. Cement edger--A small trowel with one curved edge for use on edges of slabs and sidewalks
- C. Cement groover--A tool used to form grooves in sidewalks and patios
- D. Inside corner trowel--A tool used to smooth inside corners, as on steps
- E. Outside corner trowel--A tool used to smooth outside corners such as on steps

CONCRETE WORKING TOOLS



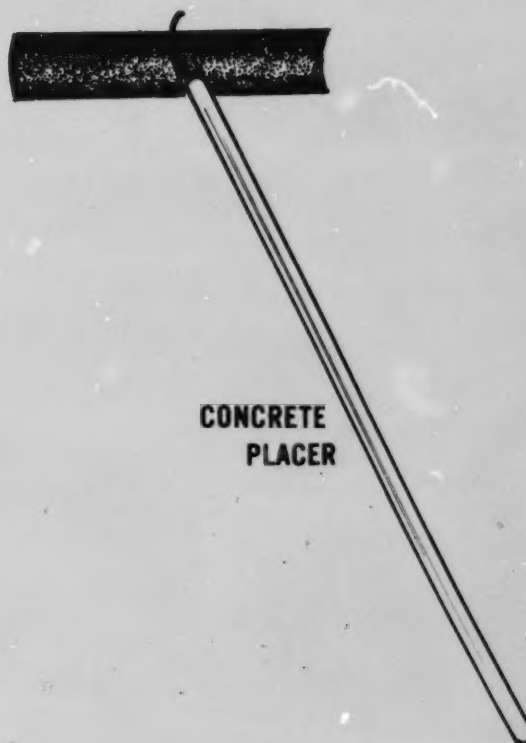
CONTRACTORS
WHEELBARROW



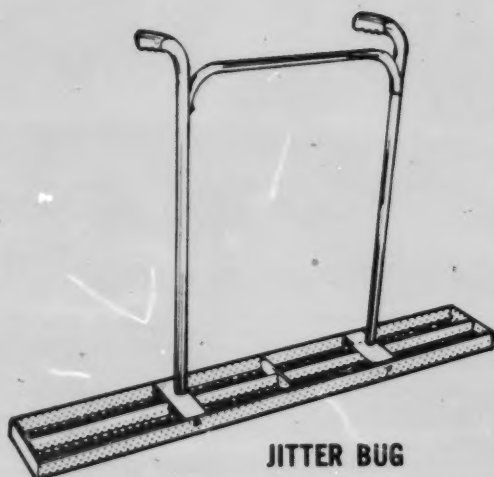
KNEE PADS



SHOVEL



CONCRETE
PLACER



JITTER BUG

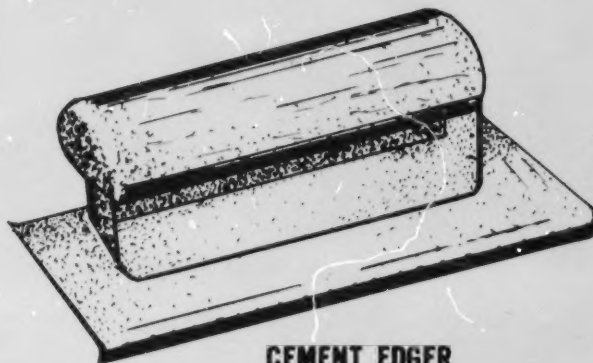


BULL FLOAT

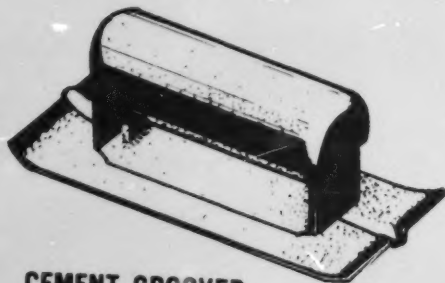
CONCRETE FINISHING TOOLS



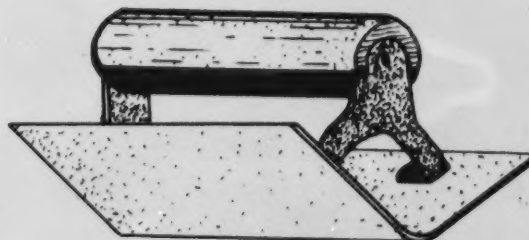
TROWEL



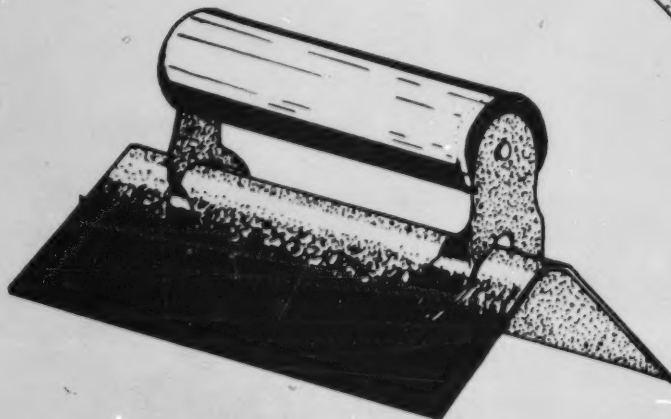
CEMENT EDGER



CEMENT GROOVER

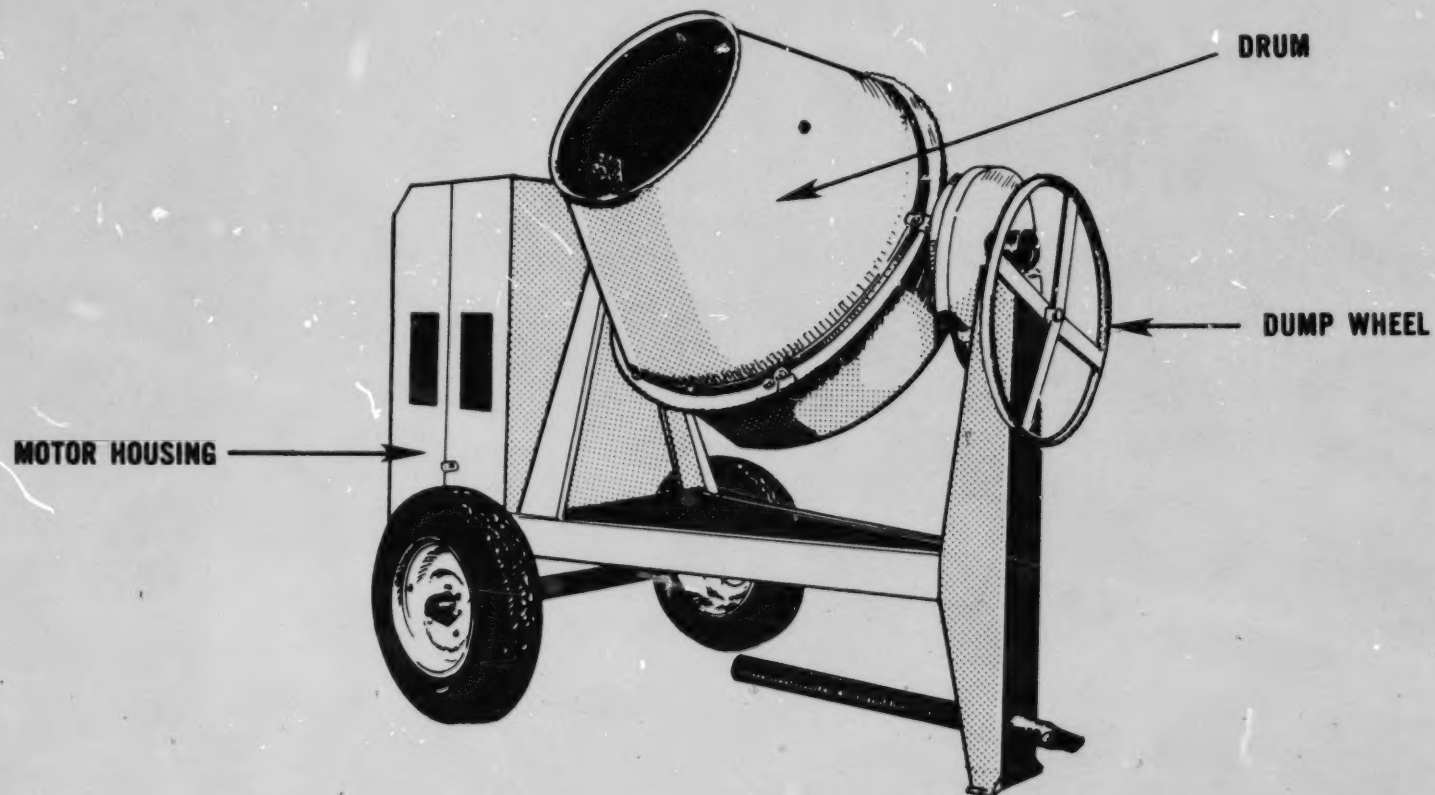


INSIDE CORNER TROWEL



OUTSIDE CORNER TROWEL

PORTABLE CONCRETE MIXER



UNIT I

CONCRETE TOOLS AND MATERIALS

ASSIGNMENT SHEET--IDENTIFY CONCRETE TOOLS

Directions: The instructor will prepare a display of each tool listed in Parts II and III of the information sheet. Each tool will be assigned a number only. On a sheet of paper, write the correct name of each tool beside the number of that tool.

(NOTE: The instructor may provide a list of names of concrete tools from which you may select your answer.)

UNIT I
CONCRETE TOOLS AND MATERIALS

UNIT TEST

1. Match the terms on the right to the correct definition on the left by placing the number in the blank.

- | | | |
|----------|--|----------------------|
| _____ a. | Crisscrossed wire usually 10 gauge used to strengthen concrete | 1. Cement |
| _____ b. | A bonding material that hardens when mixed with water | 2. Reinforcement bar |
| _____ c. | A mixture of cement, sand, gravel and water | 3. Duplex nail |
| _____ d. | Holds concrete in place until it hardens or "sets up" | 4. Screed |
| _____ e. | Wire used to tie "re-bar" together | 5. Concrete |
| _____ f. | Steel rod used to strengthen concrete | 6. Reinforcing mesh |
| _____ g. | A nail with a double head used to make forms | 7. Forms |
| | | 8. Tie wire |

2. Identify the following tools by writing the name in the blank below each concrete working tool. Choose from the list given.

Wheelbarrow
Shovel
Jitterbug

Bullfloat
Concrete placer
Knee pads



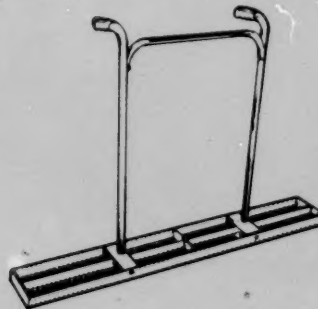
a. _____



b. _____



c. _____



d. _____



e. _____

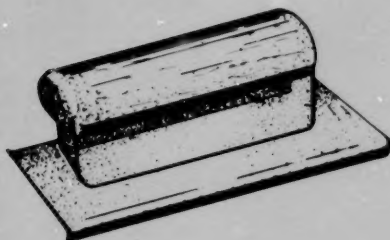


f. _____

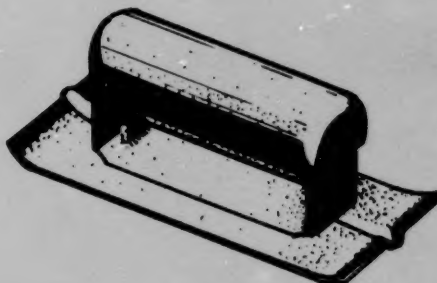
3. Identify the following tools by writing the name in the blank below each concrete finishing tool. Choose from the list given.

Inside corner trowel
Outside corner trowel
Cement edger

Cement groover
Trowel



a. _____



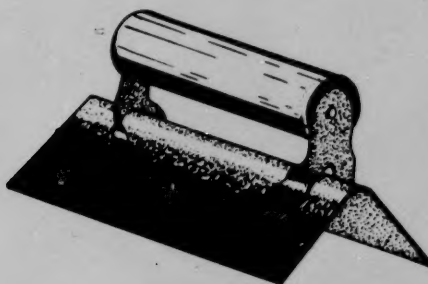
b. _____



c. _____



d. _____



e. _____

4. Demonstrate the ability to identify eleven tools on display used in concrete work

(NOTE: If this activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

UNIT I
CONCRETE TOOLS AND MATERIALS

ANSWERS TO UNIT TEST

1. 6 a.
1 b.
5 c.
7 d.
8 e.
2 f.
3 g.
2. a. Contractors wheelbarrow or wheelbarrow
b. Shovel
c. Concrete placer
d. Jitterbug
e. Knee pads
f. Bullfloat
3. a. Cement edger
b. Cement groover
c. Inside corner trowel
d. Trowel
e. Outside corner trowel
4. Evaluated to the satisfaction of the instructor

UNIT II

SITE PREPARATION, POURING, AND FINISHING

UNIT OBJECTIVE

After completing this unit, the student will be able to prepare a site, pour, and finish a concrete flagstone. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with concrete site preparation, pouring, and finishing
2. Select correct statements relating to site preparation
3. Determine the proper composition of concrete
4. Identify correct procedures for pouring concrete
5. Select correct statements relating to finishing concrete
6. Identify proper concrete curing procedures
7. List two steps in a proper clean-up after concrete work
8. Demonstrate the ability to:
 - a. Make a form for a flagstone
 - b. Pour and finish a flagstone.
 - c. Remove the forms from a flagstone.

UNIT II

SITE PREPARATION, POURING, AND FINISHING

SUGGESTED ACTIVITIES

I. Instructor

- A. Discuss unit objective
- B. Provide students with information and job sheets
- C. Prepare transparencies and lesson plans
- D. Discuss information and job sheets
- E. Organize a field trip to a construction site involving concrete work
- F. Give test
- G. Review problem areas identified by test

II. Student

- A. Discuss questions on unit objective
- B. Read and discuss information and job sheets
- C. Complete job sheets
- D. Attend field trip
- E. Take unit test
- F. Discuss test questions missed

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective Sheet
- B. Information Sheet
- C. Transparency masters
 - 1. TM-1--Site Preparation
 - 2. TM-2--Tying Rebar

D. Job sheets

1. Job Sheet #1--Making A Form For a Flagstone
2. Job Sheet #2--Pouring and Finishing a Flagstone
3. Job Sheet #3--Removing Forms From a Flagstone

E. Unit Test

F. Answers to Unit Test

II. References:

- A. Feirer, John L. and Gilbert R. Hutchings.
Carpentry and Building Construction. Peoria,
Illinois: Chas. A. Bennett Co., Inc., 1976.
- B. Wagner, Willis H. Modern Carpentry. South
Holland, Illinois: Goodheart-Wilcox Co., Inc.,
1976.

UNIT II

SITE PREPARATION, POURING, AND FINISHING

INFORMATION SHEET

I. Terms and definitions

- A. Site--Place where concrete will be poured
- B. Pouring--Placing mixed concrete into the forms
- C. Vibrating--Removing air bubbles from wet concrete
- D. Screeding--Leveling the surface of wet concrete immediately after pouring
- E. Jitterbugging--Pushing the gravel below the surface of wet concrete
- F. Floating--Bringing water and cement to the surface of a slab
- G. Finishing--Putting the final shape and surface on uncured concrete
- H. Jointing--Putting grooves in a slab to control cracking
- I. Edging--Rounding the edge of a slab to prevent chipping or damage
- J. Troweling--Smoothing the surface on concrete
- K. Curing--A process within the concrete that makes it solid
- L. Grade stake--A pointed piece of wood placed to show the correct height of the slab as the concrete is poured
- M. Spreaders--Wood or metal strips used to keep forms spread apart

II. Site preparation (Transparency #1)

A. Forms

- 1. Ground surface should be cleared and leveled
- 2. Forms should be strong enough to hold concrete

3. Top edge of forms will be the surface level of the slab

4. Forms should not leak

B. Fill sand

1. Forms a cushion for the slab

2. Reduces amount of concrete needed to fill a form

3. Serves as a bottom for slab form

C. Rebar (Transparency #2)

1. Bend around corners

2. Overlap at least 1 inch at joints

3. Raised above fill sand by placing bricks or rocks under it

D. Remesh

1. Area to be covered is measured.

2. Wire is cut to size.

(Note: If lapping remesh is necessary to cover area, overlap at least 6 inches.)

3. Remesh should be raised above fill sand.

4. If rebar is also used, remesh should be tied to rebar.

(Caution: Once steel or remesh is in place, footing becomes very hazardous--watch your step!)

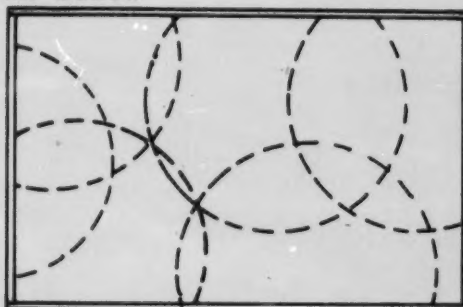
E. Grade stakes

(Note: Grade stakes may not be necessary on small jobs.)

1. Placed where needed to determine height of forms

2. Driven down slowly until stake is at correct height

4. Amount of pressure to apply will vary, depending upon how much the concrete has set up
5. Trowel in overlapping semi-circles as shown below



6. Edge the corners with cement edger
 7. Re-trowel surface and edges if necessary
- (Note: It may be necessary to trowel as many as 3 times to get desired finish.)

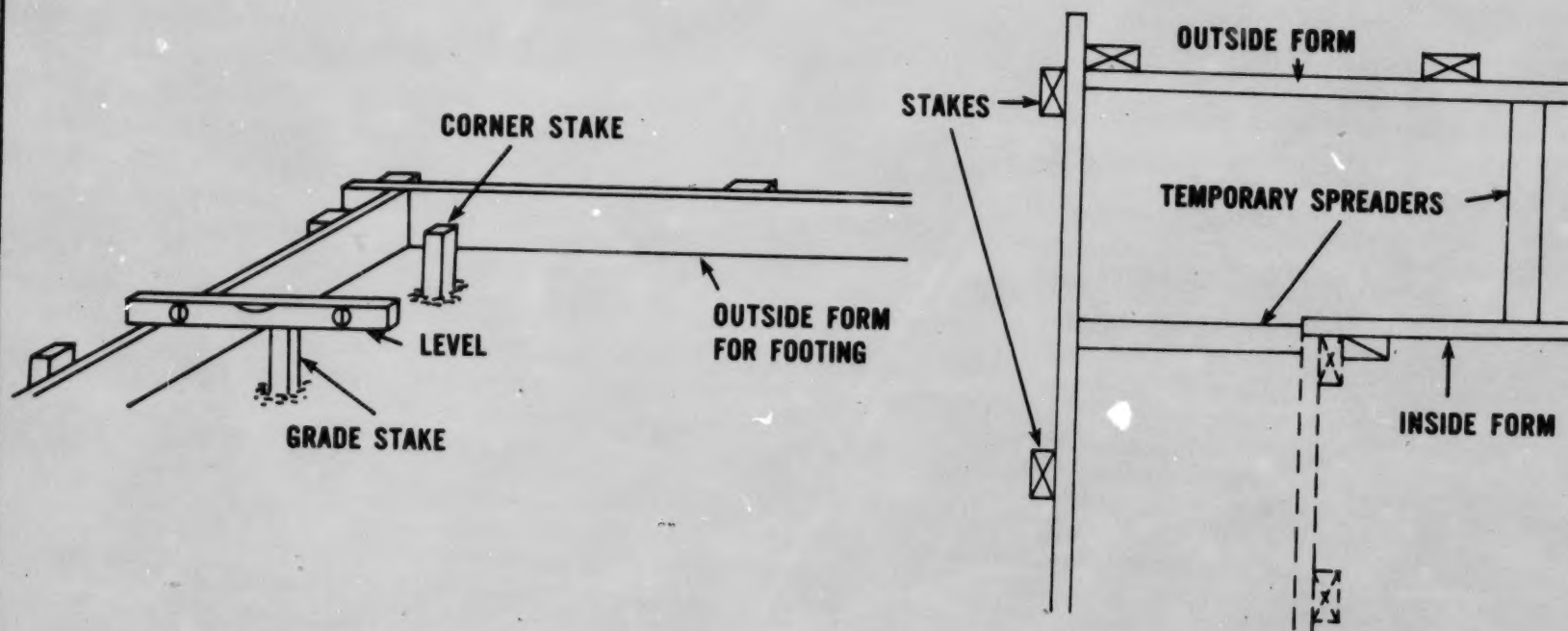
VI. Curing procedures

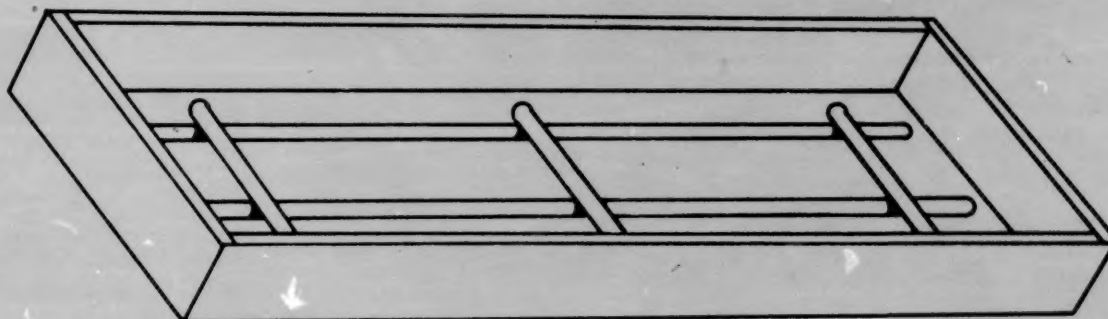
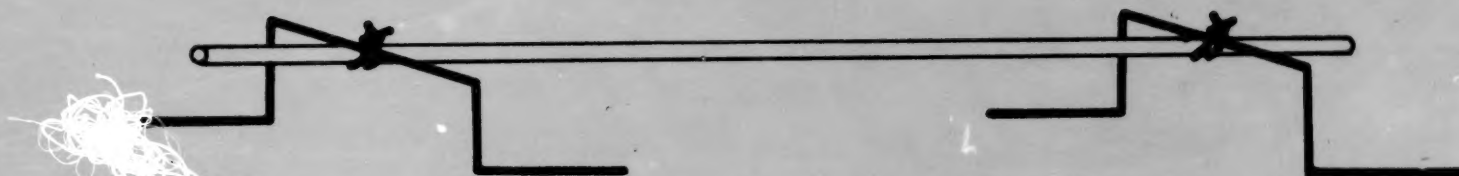
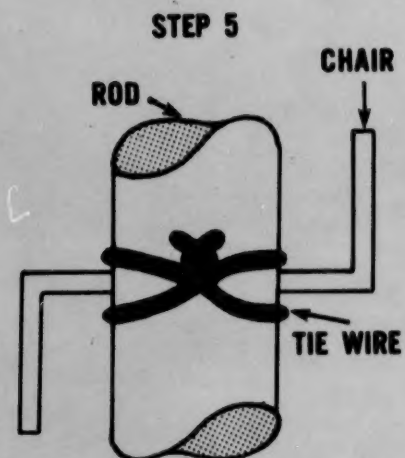
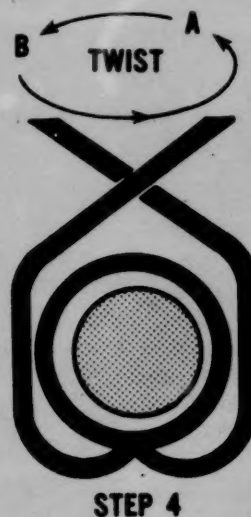
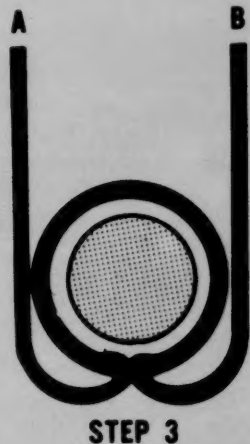
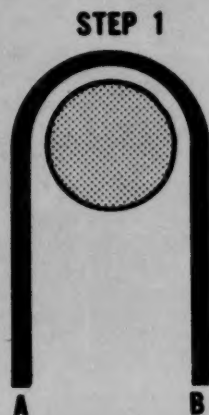
- A. Protect concrete from rapid drying
- B. Keep the concrete above freezing until it has set
- C. Concrete should be allowed to cure for at least 2 days before working on top of slab

VII. Clean up

- A. Use water to clean all tools and equipment immediately after use
- B. Wash all concrete from your skin

SITE PREPARATION





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UNIT II

SITE PREPARATION, POURING, AND FINISHING

JOB SHEET #1--MAKING A FORM FOR A FLAGSTONE

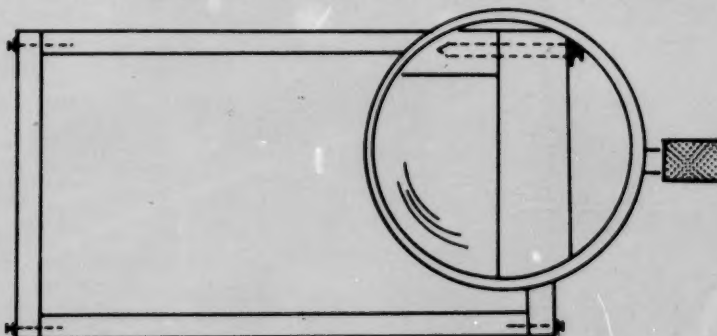
I. Tools and materials

- A. Hammer
- B. Framing square
- C. 24-inch level
- D. 16 d duplex nails
- E. 2 pieces 2 x 4 x 16"
- F. 2 pieces 2 x 4 x 19 1/4"
- G. 15" x 15" piece of remesh
- H. 8 stakes

II. Procedure

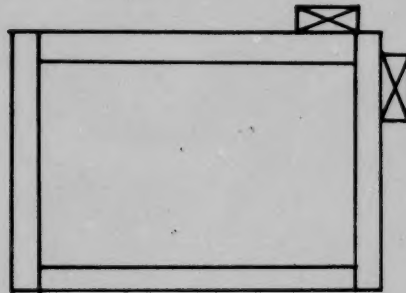
- A. Level and clear ground where form will be placed
- B. Nail 4 pieces of 2 x 4s together as shown below.

(Note: Drive duplex nails in snugly to first head.)



- C. Use two nails at each corner.
- D. Lay forms in positions and check for squareness with square

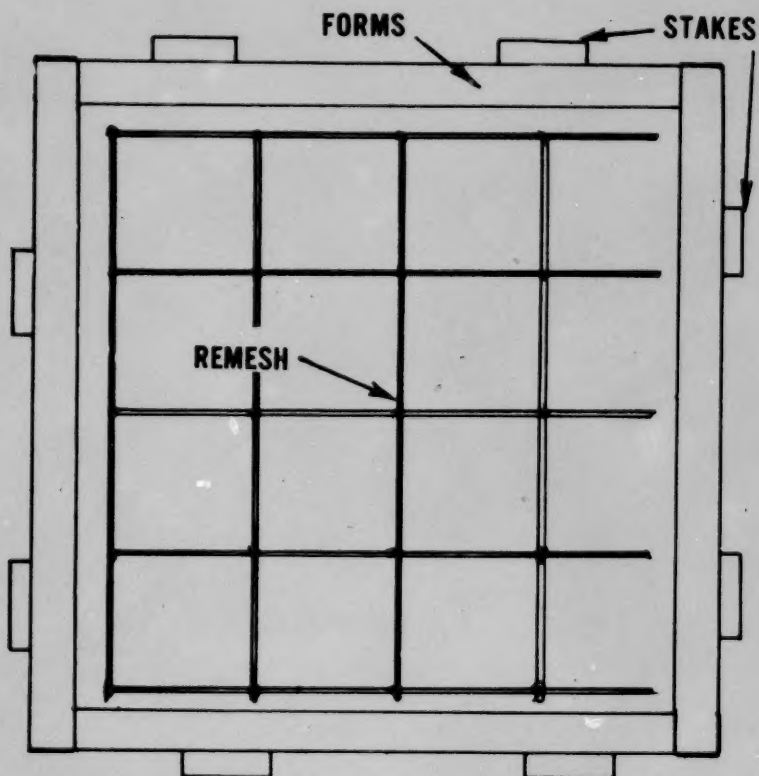
E. Drive 2 stakes in at one corner as shown below



F. Check outside corners for squareness

G. Drive in other 6 stakes

H. Place remesh in form as shown below



UNIT II

SITE PREPARATION, POURING, AND FINISHING

JOB SHEET #2--POURING AND FINISHING A FLAGSTONE

I. Tools and materials

- A. Sand
- B. Gravel
- C. Cement
- D. Water
- E. Wheelbarrow
- F. Shovel
- G. Hammer
- H. Screed
- I. Cement edger
- J. Trowel

II. Procedure

- A. Mix sand, gravel, and cement in proper proportions in wheelbarrow
- B. Add proper amount of water
- C. Mix thoroughly until all lumps and dry pockets are blended
- D. Pour into form
- E. Vibrate by striking without moving form
- F. Screed surface of concrete
- G. Trowel surface of concrete
- H. Edge, using cement edger
- I. Trowel again, if necessary
- J. Clean tools and equipment
- K. Store tools and equipment properly
- L. Clean area and wash your hands

UNIT II

SITE PREPARATION, POURING, AND FINISHING

JOB SHEET #3--REMOVING FORMS FROM A FLAGSTONE

- I. Tools and materials
 - A. Hammer
 - B. Shovel
- II. Procedure
 - A. Pull duplex nails from form
 - B. Tap stakes from side to side until loose in soil
 - C. Pull stakes out of ground
 - D. Tap forms and remove from flagstone
 - E. Push loose dirt into stake holes with shovel
 - F. Clean up area
 - G. Store tools properly

UNIT II

SITE PREPARATION, POURING, AND FINISHING

UNIT TEST

1. Match the terms on the right to the correct definition on the left by placing the number in the blank.

- | | |
|--|------------------|
| ___ a. Leveling the surface of wet concrete after pouring | 1. Vibrating |
| ___ b. A process used to remove air bubbles from wet concrete | 2. Trowling |
| ___ c. Putting grooves in a slab to control cracking | 3. Curing |
| ___ d. Rounding the edge of a slab to prevent chipping | 4. Jointing |
| ___ e. Makes a smooth surface on concrete | 5. Floating |
| ___ f. A process within the concrete that makes it solid | 6. Jitterbugging |
| ___ g. Brings water and cement to the surface of a slab | 7. Screeding |
| ___ h. Pushes the gravel below the surface of wet concrete | 8. Edging |
| ___ i. Putting the final shape and surface on uncured concrete | 9. Pouring |
| ___ j. Placing wet concrete into the forms | 10. Finishing |

2. Select the correct statements below relating to site preparation by placing a "✓" in the blank beside the correct statement only.

- ___ a. Forms should be strong enough to hold the concrete
- ___ b. It is OK if forms leak a little
- ___ c. Fill sand forms a cushion for the slab
- ___ d. Fill sand reduces the amount of concrete needed to

fill a form

- ☐ e. Rebar should be cut off rather than bent around corners
 - ☐ f. Rebar should be raised off fill sand by placing bricks or rocks under it
 - ☐ g. Remesh should be raised off the fill sand
 - ☐ h. If rebar is also used, remesh should be tied to the rebar
 - ☐ i. Grade stakes are placed where needed to determine height of the form
 - ☐ j. Grade stakes should be driven down slowly to the correct height
3. Determine the proper composition of concrete by placing the correct number in the blank beside each part.
- a. ☐ part(s) of portland cement
 - b. ☐ part(s) of sand
 - c. ☐ part(s) of gravel
4. Identify the correct procedures for pouring concrete by placing a "✓" in the blank beside each true statement.
- ☐ a. Always fill beam last
 - ☐ b. Pouring too fast may move forms
 - ☐ c. Pour farthest corner last
 - ☐ d. Fill to top of forms
5. Select the correct statements below relating to concrete finishing by placing an "X" in the blank.
- ☐ a. Use a hammer to strike forms if there is no vibrator
 - ☐ b. Do not let vibrator touch forms
 - ☐ c. A screed must be straight
 - ☐ d. The screed must be held down on top of the forms while screeding

- ___ e. Push concrete into your tracks with the jitterbug
 - ___ f. Strike the top of the forms with the jitterbug
 - ___ g. Use knee boards when floating concrete if you must be on the concrete
 - ___ h. Too much floating will result in a poor finish
 - ___ i. Troweling too soon or too late will result in poor finishes
 - ___ j. The forward edge of the trowel should be on the surface of the concrete
6. Identify the proper curing procedures below by placing a "✓" in the blank beside the correct statements only.
- ___ a. Protect concrete from rapid drying
 - ___ b. Keep the concrete from freezing only until it is poured
 - ___ c. Concrete should be allowed to cure at least 2 days before working on top of it
7. List two steps in a proper clean up after doing concrete work
- a.
 - b.
8. Demonstrate the ability to:
- a. Make a form for a flagstone
 - b. Pour and finish a flagstone
 - c. Remove the forms from a flagstone
- (Note: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT II

SITE PREPARATION, POURING, AND FINISHING

ANSWERS TO UNIT TEST

1. 7 a.
 1 b.
 4 c.
 8 d.
 2 e.
 3 f.
 5 g.
 6 h.
 10 i.
 9 j.

2. ✓ a.
 b.
 ✓ c.
 ✓ d.
 e.
 ✓ f.
 ✓ g.
 ✓ h.
 ✓ i.
 ✓ j.

3. a. 1
 b. 2
 c. 3

4. a.
 ✓ b.
 ✓ c.
 d.

5. ✓ a.
 ✓ b.
 ✓ c.
 ✓ d.
 e.
 f.
 ✓ g.
 ✓ h.
 ✓ i.
 j.

6. ✓ a.
 b.
 ✓ c.

7. a. Clean tools and equipment with water
b. Wash concrete from your skin
8. (a-c) Evaluated to the satisfaction of the instructor

UNIT I

STEEL AND COPPER PIPE AND FITTINGS

UNIT OBJECTIVE

After completing this unit, the student will be able to identify tools and materials associated with joining steel and copper pipe. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with steel and copper pipe and fittings.
2. Identify types of standard steel pipe.
3. Select sizes of steel pipe.
4. Identify pipe fittings.
5. List three methods of pipe measurement.
6. Determine true statements about threads and threading.
7. List three tools or materials used when working with steel pipe.
8. Identify types of copper tubing.
9. Select types of copper tubing fittings.
10. Identify tools used with copper tubing.
11. List three tools used in plumbing.
12. Demonstrate the ability to:
 - a. Cut steel pipe with tubing cutter
 - b. Ream steel pipe
 - c. Thread steel pipe
 - d. Make a 90° bend in copper tubing

- e. Flare copper tubing
- f. Solder a sweat joint

UNIT I

STEEL AND COPPER PIPE AND FITTINGS

SUGGESTED ACTIVITIES

I. Instructor:

- A. Discuss unit objective
- B. Provide student with information and job sheet
- C. Prepare transparencies and lesson plans
- D. Prepare a wood block with various size holes 5/8 to 3/4 inch deep to hold sweat solder fittings while soldering
- E. Give demonstrations
- F. Give test
- G. Review problem areas identified by test

II. Student:

- A. Discuss questions of unit objectives
- B. Read and discuss information and job sheets
- C. Complete job sheets
- D. Take test
- E. Discuss questions missed on test

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
 - 1. I-TM-1--Pipe Fitting Allowance
 - 2. I-TM-2--Sweat Solder Fittings
 - 3. I-TM-3--Flare Fittings

4. I-TM-4--Compression Fittings
5. I-TM-5--General Plumbing Tools - Part I
6. I-TM-6--General Plumbing Tools - Part II

D. Job sheets

1. Job Sheet #1--Cut Steel Pipe with Tubing Cutter
2. Job Sheet #2--Ream Steel Pipe
3. Job Sheet #3--Thread Steel Pipe
4. Job Sheet #4--Make a 90° Bend in Copper Tubing
5. Job Sheet #5--Flare Copper Tubing
6. Job Sheet #6--Solder a Sweat Joint

E. Unit test

F. Answers to unit test

II. References:

- A. Slateo, Harry. Plumbing I. Albany, New York: Delmar Publishers, 1974.
- B. How to Design and Install Plumbing. American Technical Society. Library of Congress Number 60-1968 ISBN 0-8269-059-1.
- C. General Construction Trades. Stillwater, Oklahoma: State Department of Vocational and Technical Education, 1971.
- D. Daniels, George. Plumbing, Heating and Air Conditioning. New York, New York: Popular Science Publishing Co., Harper & Row, 1972.

UNIT I

STEEL AND COPPER PIPE AND FITTINGS

INFORMATION SHEET

I. Terms and definitions

- A. P.S.I.--Pounds per square inch
- B. I.P.T.--Iron pipe thread (American Standard)
- C. O.D.--Outside diameter
- D. I.D.--Inside diameter
- E. Nominal size--Near inside measurement
- F. Burr--Rough edge on end of pipe
- G. Male end--End of pipe having outside threads
- H. Female end--End of pipe having inside threads
- I. Standard--Regularly accepted practice
- J. Oxidize--Combine with oxygen
- K. Solder flux--Mildly corrosive acid used to clean a surface to be soldered

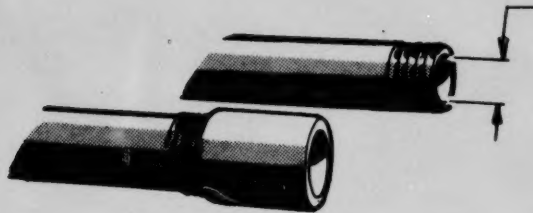
II. Types of standard steel pipe

- A. Galvanized--Has a zinc coating, inside and out, to prevent rust
- B. Black pipe--Uncoated steel pipe
- C. Coated pipe--Black pipe that has been coated for some special purpose

III. Sizes of standard steel pipe

- A. Measured by inside diameter (I.D.) and called nominal size
- B. Sizes
 - 1. Range from 1/8 inch to 10 inches I.D.
 - 2. Nominal sizes: 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1 1/4, 1 1/2, 2, 2 1/2, 3, 4 to 10 inches

- C. Manufactured in various lengths
- D. Usually threaded on both ends with a coupling on one end



IV. Pipe fittings and nipples

A. Fittings

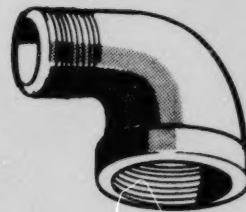
1. 90° elbow (ell)



2. 45° elbow



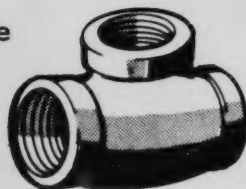
3. 90° street elbow (str ell)



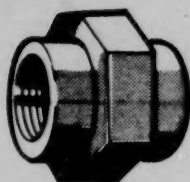
4. 45° street elbow



5. Tee



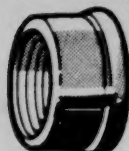
6. Union



7. Bushing



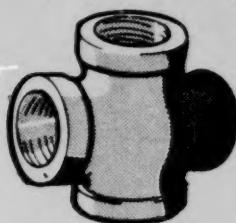
8. Cap



9. Coupling



10. Cross



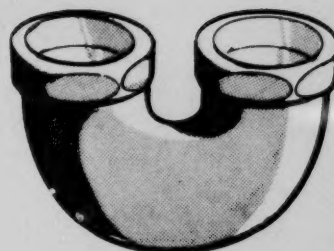
11. Plug



12. Reducer



13. Return bend



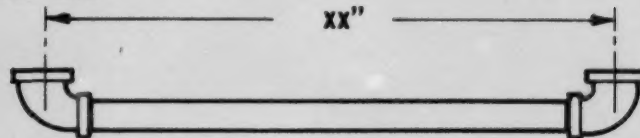
B. Steel Nipples--Length up to 12 inches



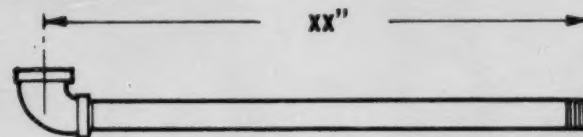
V. Pipe measurement and fitting allowance

A. Three methods of measurement

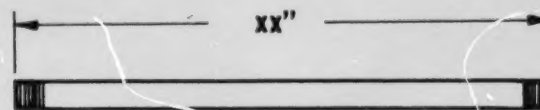
1. End-to-end



2. End-to-center



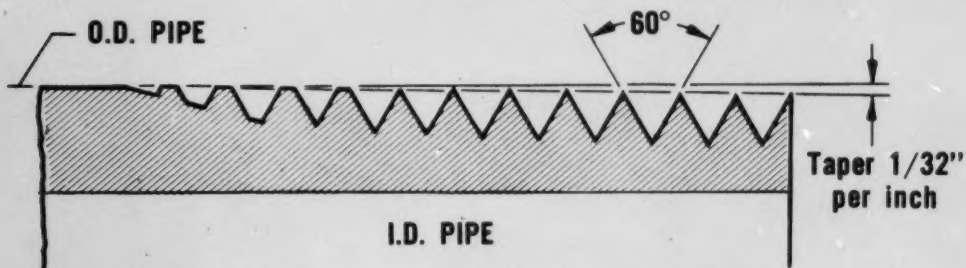
3. Center-to-center



B. Fitting allowance (Transparency #1)

VI. Threads and threading

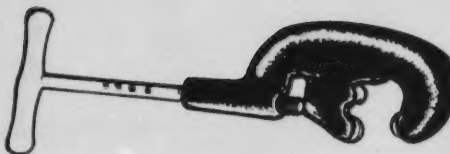
- A. Provide water-tight seal at all connections
- B. Provide strong holding connection
- C. American Standard Thread is the standard pipe thread
- D. Tapered to assure strong water-tight hold



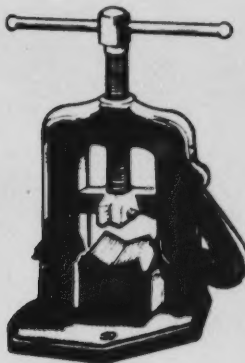
VII. Tools and material used on steel pipe

- A. Hacksaw

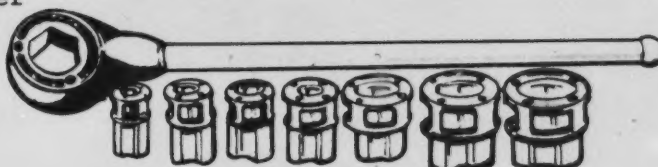
B. Pipe cutter



C. Pipe vise



D. Ratchet threader



E. Pipe reamer



F. Pipe wrench



G. Thread cutting oil



H. Thread sealing compound



VIII. Types of copper tubing

A. Type K

1. Can be hard or soft tempered

(NOTE: Tempering is a process which changes the hardness of metal)

2. Hard temper is used with solder joints for new plumbing
3. Soft temper bends easily and is used with flare fittings for:
 - a. Repairs
 - b. Underground lines
 - c. Gas service lines

B. Type L

1. Tubing wall is thinner than Type K
2. Can be hard or soft tempered
3. Soft tempered is used with flare fitting for repairs
4. Hard temper is used with solder joints for new plumbing

C. Type M

1. Tubing wall is thinner than Type L
2. Soft tempered
3. Used for low pressure lines such as:
 - a. Water supply to evaporative coolers
 - b. fixture supplies
 - c. small drains
 - d. low pressure gas supply to stoves and furnaces

IX. Types of fittings for copper tubing

- A. Sweat solder joint fittings--Used for hard temper tubing (Transparency #2)
- B. Flare fittings--Used for soft temper tubing (Transparency #3)

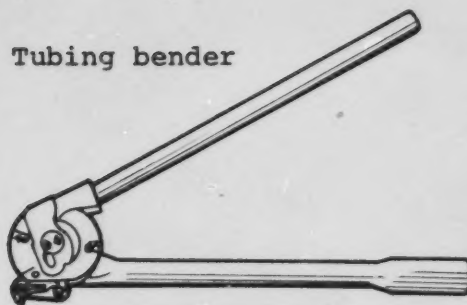
C. Compression fitting--Used for soft temper and refrigeration tubing (Transparency #4)

X. Tools used on copper tubing

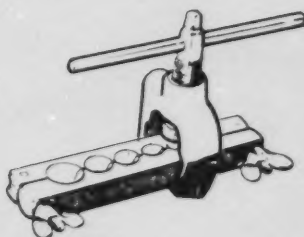
A. Tubing cutter



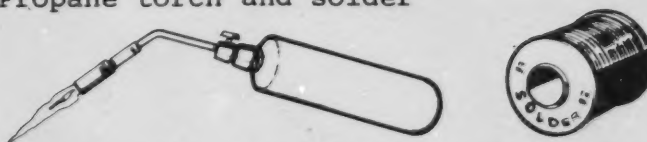
B. Tubing bender



C. Flaring tool



D. Propane torch and solder



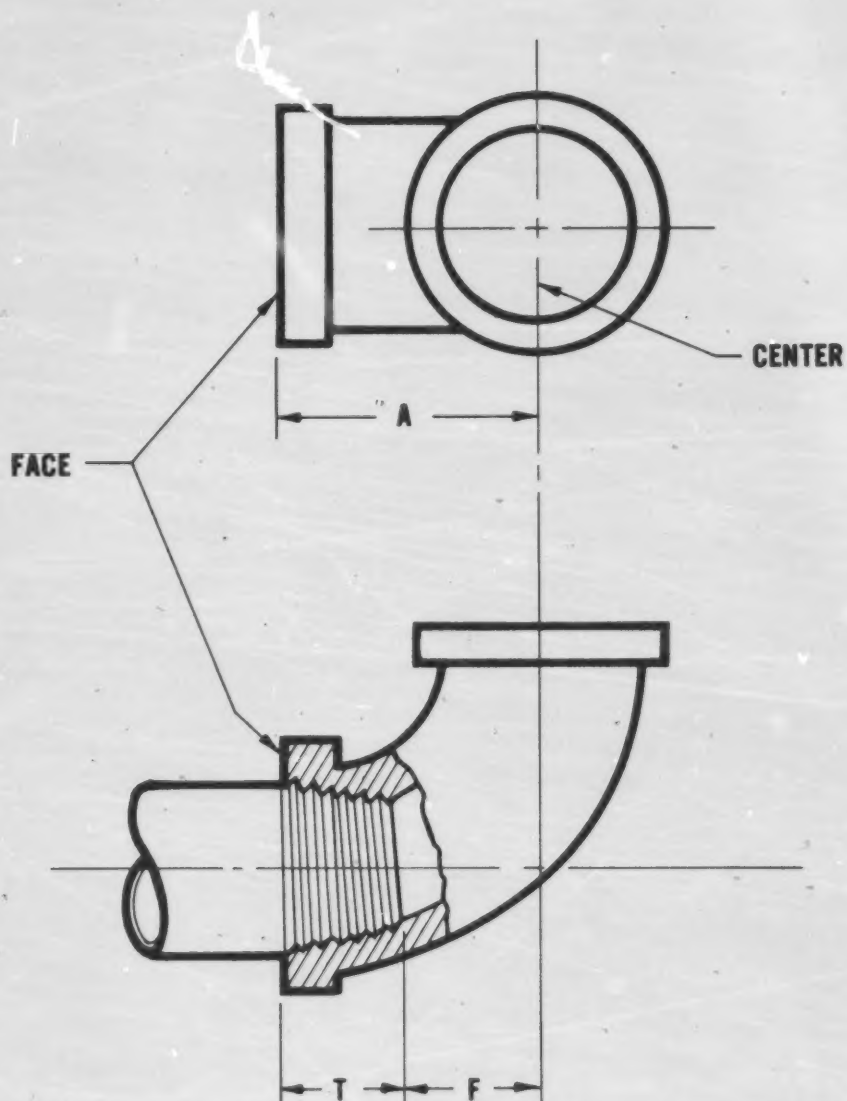
XI. General plumbing tools (Transparency #5 and #6)

A. Hand saw

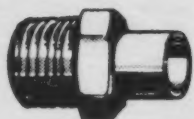
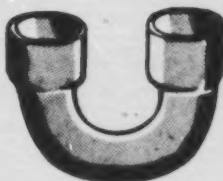
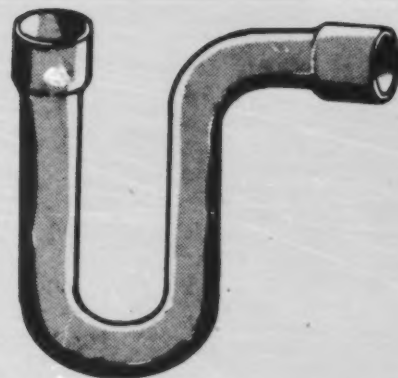
B. Keyhole saw

- C. Circular saw
- D. Cold chisel
- E. Wood chisel
- F. Folding rule
- G. Claw hammer
- H. Drain spade
- I. Adjustable wrench
- J. Pipe jaw pliers

PIPE FITTING ALLOWANCE



SWEAT SOLDER FITTINGS

**90° ELBOW****45° ELBOW****STREET ELBOW****CAP****TEE****SWEAT TO PIPE****SWEAT TO FLARE****SWEAT TO FLARE SWIVEL****COUPLING****COUPLING REDUCER****RETURN BEND****SUCTION LINE TRAPS**

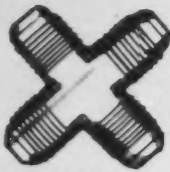
FLARE FITTINGS



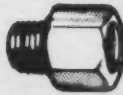
MALE ELBOW



45° MALE ELBOW



CROSS



FEMALE COUPLING



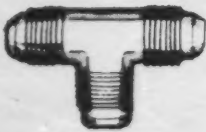
MALE CONNECTOR



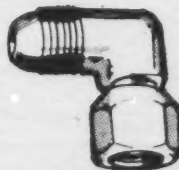
LONG NUT



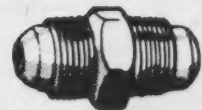
CAP NUT



TEE



FEMALE SWIVEL ELBOW



UNION



FEMALE UNION



PLUG



REDUCER

COMPRESSION FITTINGS



SLEEVE



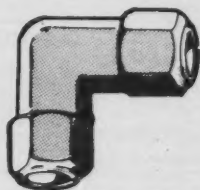
NUT



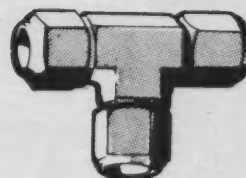
UNION



COMPRESSION TO PIPE
UNION



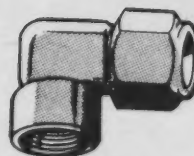
UNION ELBOW



UNION TEE



FEMALE CONNECTOR



FEMALE ELBOW

GENERAL PLUMBING TOOLS

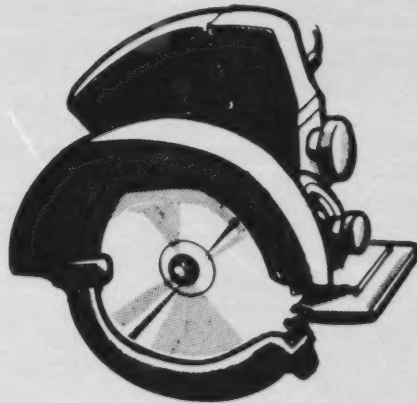
PART I



HAND SAW



KEYHOLE SAW



CIRCULAR SAW



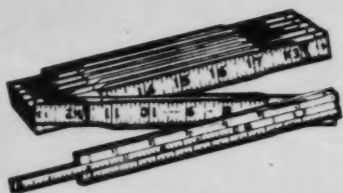
COLD CHISEL



WOOD CHISEL

GENERAL PLUMBING TOOLS

PART II



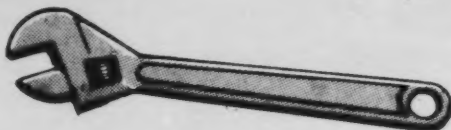
FOLDING RULE



CLAW HAMMER



DRAIN SPADE



ADJUSTABLE WRENCH



PIPE JAW PLIARS

UNIT I

STEEL AND COPPER PIPE AND FITTINGS

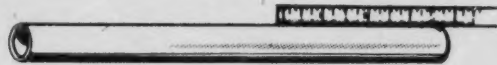
JOB SHEET #1--CUT STEEL PIPE WITH TUBING CUTTER

I. Tools and materials

- A. Pipe vise
- B. Hack saw
- C. Folding rule
- D. Pipe cutter
- E. Length of pipe (1/2 or 3/4 inch diameter)

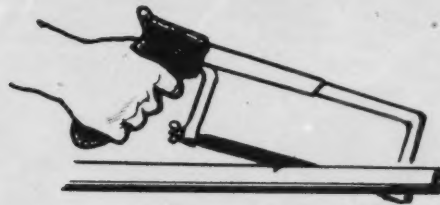
II. Procedure

- A. Measure length to be cut with folding rule



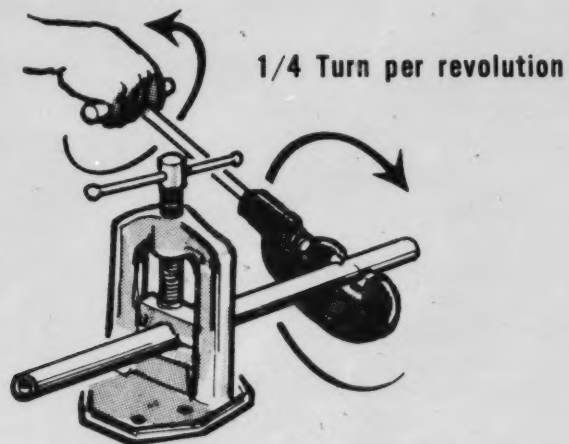
- B. Mark the pipe using the hack saw

(NOTE: Pull the hack saw across the pipe rather than push when marking only.)



- C. Fasten the pipe in the vise with mark at least 4 inches from vise
- D. Place pipe cutter on pipe
- E. Tighten cutter on pipe until cutting wheel is snug on pipe

F. Rotate pipe cutter in direction shown below



G. After each rotation, turn cutter handle 1/4 turn

H. Repeat step G until pipe is cut to length

I. Clean and store tools properly

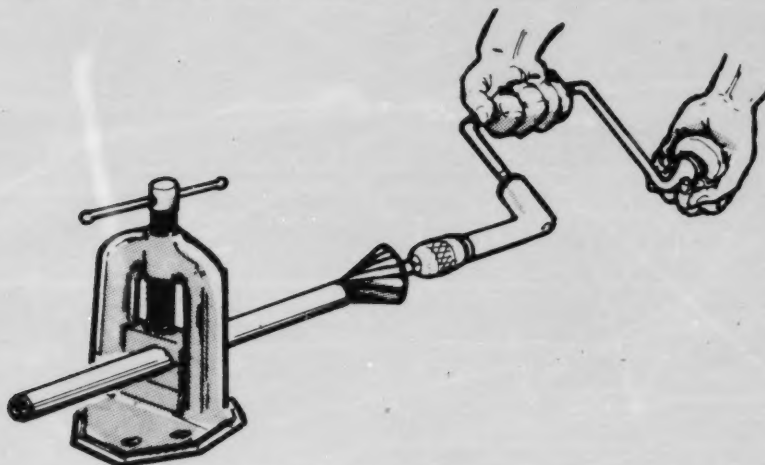
J. Wash your hands

UNIT I

STEEL AND COPPER PIPE AND FITTINGS

JOB SHEET #2--REAM STEEL PIPE

- I. Tools and materials
 - A. Pipe vise
 - B. Pipe reamer
 - C. Length of pipe (Use piece cut in Job Sheet #1.)
- II. Procedure
 - A. Fasten pipe in vise
 - B. Place reamer in end of pipe
 - C. Turn reamer clockwise until burr is removed



- D. Check to be sure all burrs are removed
- E. Clean and store tools properly
- F. Wash your hands

UNIT I

STEEL AND COPPER PIPE AND FITTINGS

JOB SHEET #3--THREAD STEEL PIPE

I. Tools and materials

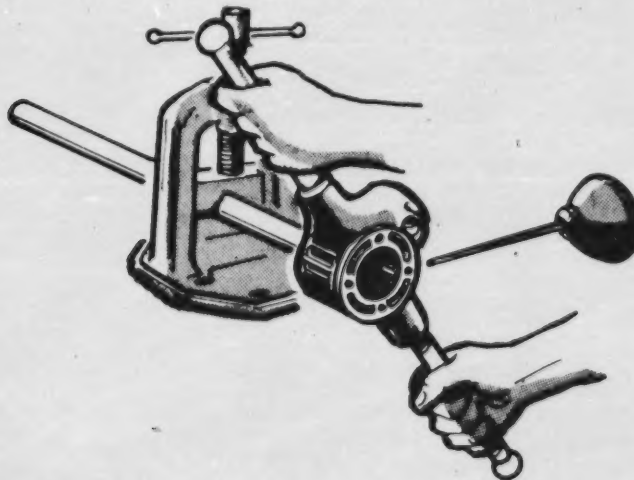
- A. Pipe vise
- B. File
- C. Correct size pipe threader
- D. Cutting oil
- E. Wire brush
- F. Pipe prepared from Job Sheets #1 and #2

II. Procedure

- A. Place pipe in vise
- B. Remove burrs on outside of pipe using the file
- C. Place threader on pipe

(NOTE: Be sure threader is flat against end of pipe.)

- D. Keep threading oil on area to be threaded



- E. Continue threading until one thread is out of threader

- F. Screw off threader and inspect the threads
- G. Clean threads with the wire brush
- H. Clean and store tools properly
- I. Wash your hands

UNIT I

STEEL AND COPPER PIPE AND FITTINGS

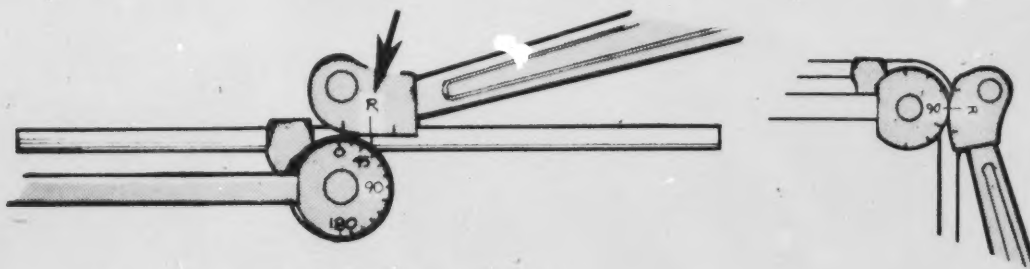
JOB SHEET #4--MAKE A 90° BEND
IN COPPER TUBING

I. Tools and materials

- A. Tubing cutter
- B. 3/8 inch level type tubing bender
- C. Twelve inches of 3/8 inch O.P. copper tubing

II. Procedure

- A. Measure six inches from one end of tubing and make a mark
- B. Put tubing in bender so "R" mark is even with the mark on the tubing
- C. Pull lever until "R" mark is even with 90° mark



- D. Remove bender from tubing
- E. Have instructor check your work
- F. Store tools properly
- G. Wash your hands

UNIT I

STEEL AND COPPER PIPE AND FITTINGS

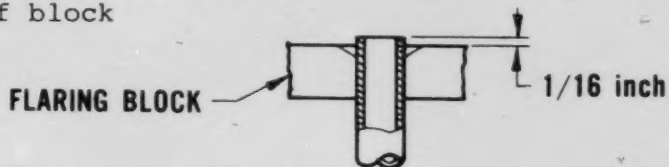
JOB SHEET #5--FLARE COPPER TUBING

I. Tools and materials

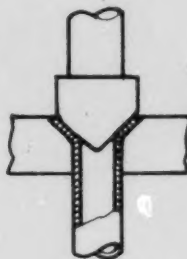
- A. Tubing cutter
- B. Flaring tool
- C. Folding rule
- D. Copper tubing from Job Sheet #4

II. Procedure

- A. Open flaring tool block
- B. Place tubing in correct hole
- C. Tubing should be 1/16 inch above the tapered hole side of block



- D. Close block and tighten wing nut
- E. Slide flaring tool onto block and center over tubing
- F. Tighten flaring tool until it is snug against block



- G. Remove flaring tool from block
- H. Remove tubing from block
- I. Have instructor check your work

J. Clean and store tools properly

K. Wash your hands



UNIT I

STEEL AND COPPER PIPE AND FITTINGS

JOB SHEET #6--SOLDER A SWEAT JOINT

I. Tools and materials

- A. 3/8 inch copper tubing
- B. 3/8 inch copper sweat fitting
- C. Tubing cutter with reamer
- D. Fine sandpaper
- E. Clean damp cloth
- F. Propane torch
- G. Solder
- H. Solder flux
- I. Safety glasses
- J. Soldering block

II. Procedures

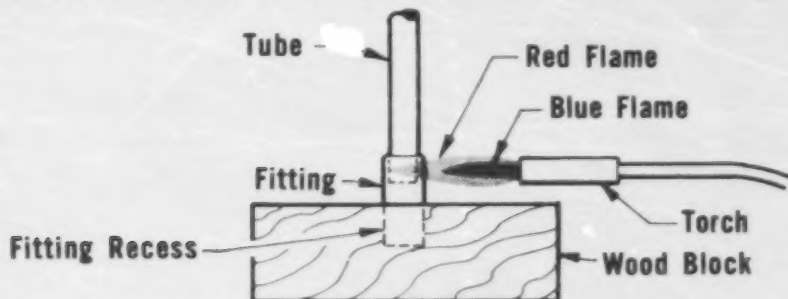
- A. Cut tubing to length with tubing cutter
- B. Remove burr from inside of tubing with reamer on tubing cutter



- C. Sand outside of tubing at end to be soldered
- D. Wipe with clean cloth

(NOTE: Do not touch cleaned area since body moisture will cause surface to oxidize.)

- E. Apply a thin film of flux to cleaned end of tubing
(NOTE: Use the brush on the lid of the flux can.)
- F. Insert tubing into fitting
(NOTE: Twist the tubing while inserting into fitting to spread flux evenly.)
- G. Wipe off excess flux with the clean cloth
- H. Place fitting in soldering block
- I. Put on safety glasses
- J. Light torch and adjust flame
- K. Apply heat to entire joint holding blue flame about 1/8 inch from joint



- L. Apply solder to joint
(NOTE: Do not allow flame to melt solder. When joint has been heated to proper temperature, solder will melt and flow into fitting joint. If solder does not melt on contact with fitting, reheat joint.)
- M. Remove heat when solder flows from joint
- N. Turn off torch and allow solder to cool
- O. Have instructor check you work
- P. Clean and store tools properly
- Q. Wash your hands

UNIT I

STEEL AND COPPER PIPE AND FITTINGS

UNIT TEST

1. Match the plumbing terms in the right hand column to the correct definition on the left. Place the number in the blank.

_____ a. Outside diameter	1. I. D.
_____ b. Pounds per square inch	2. O. D.
_____ c. Iron Pipe Thread	3. I. P. T.
_____ d. Inside diameter	4. P. S. I.
_____ e. Rough edge on end of pipe	5. Burr
_____ f. Combine with oxygen	6. Male end
_____ g. Mildly corrosive acid used to clean surface to be soldered	7. Female end
_____ h. End of pipe having outside threads	8. Oxidize
_____ i. End of pipe having inside threads	9. Solder flux

2. Identify the types of standard steel pipe below. Place a "✓" in blank beside each of the correct types.

_____ a. Galvanized
_____ b. Brown
_____ c. Black
_____ d. Coated

3. Select the true statements about sizes of standard steel pipe. Place a "✓" in the blank.

_____ a. Measured by inside diameter
_____ b. Measured by outside diameter
_____ c. Sizes range from 1/8 inch to 10 inches I. D.

_____ d. Steel pipe is manufactured in only one length

_____ e. Lengths are usually threaded on both ends

4. Identify the pipe fittings. Write the name of each in the blank. Select your answer from the list below.

90° elbow

Cross

Plug

Tee

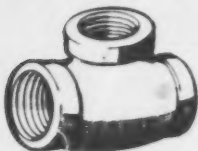
Coupling

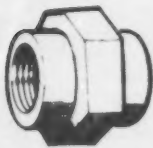
Cap

Union

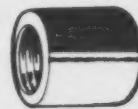
Reducer

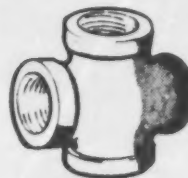
















5. List three methods of pipe measurement.

a. _____

b. _____

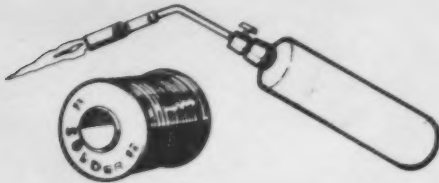
c. _____

6. Determine which of the statements are true about threads and threading. Place a "/" in the blank.
- _____ a. Threads provide a water tight seal at connections
 - _____ b. Threads provide a strong holding connection
 - _____ c. Pipe threads are straight
 - _____ d. American Standard Thread is the standard pipe thread
7. List three tools or materials used when working with steel pipe.
- a. _____
 - b. _____
 - c. _____
8. Identify the types of copper tubing. Place a "/" in the blank beside the correct types.
- _____ a. Type M
 - _____ b. Type K
 - _____ c. Type L
 - _____ d. Type O
 - _____ e. Type N
9. Select the types of fittings used on copper tubing. Place a "/" in the blank.
- _____ a. Sweat solder joint
 - _____ b. Flare
 - _____ c. Retention
 - _____ d. Compression

10. Identify the tools used on copper tubing. Select answer from the list below. Write your answer in the blank.

Tubing cutter

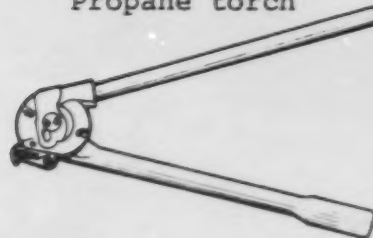
Tubing bender



a. _____

Flaring tool

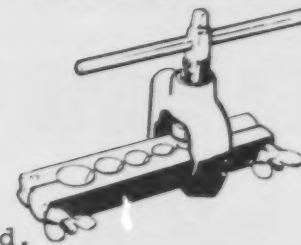
Propane torch



b. _____



c. _____



d. _____

11. List three tools used in plumbing.

a. _____

b. _____

c. _____

12. Demonstrate the ability to:

a. Cut steel pipe with tubing cutter

b. Ream steel pipe

c. Thread steel pipe

d. Make a 90° bend in copper tubing

e. Flare copper tubing

f. Solder a sweat joint

(Note: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT I

STEEL AND COPPER PIPE AND FITTINGS

ANSWERS TO UNIT TEST

1. 2 a.4 b.3 c.1 d.5 e.8 f.9 g.6 h7 i.2. ✓ a. b.✓ c.✓ d.3. ✓ a. b.✓ c. d.✓ e.

4. a. 90° elbow

b. Tee

c. Union

d. Cross

e. Coupling

f. Reducer

g. Plug

h. Cap

5. a. End-to-end
b. End-to-center
c. Center-to-center
6. ☒ a.
☒ b.
☐ c.
☒ d.
7. Any three of these:
a. Hacksaw
b. Pipe cutter
c. Pipe vise
d. Ratchet threader or threader
e. Pipe reamer
f. Pipe wrench
g. Thread cutting oil
h. Thread sealing compound
8. ☒ a.
☒ b.
☒ c.
☐ d.
☐ e.
9. ☒ a.
☒ b.
☐ c.
☒ d.
- 77

10.
 - a. Propane torch
 - b. Tubing bender
 - c. Tubing cutter
 - d. Flaring tool
11. Any three of these:
 - a. Handsaw
 - b. Keyhole saw
 - c. Circular saw
 - d. Cold chisel
 - e. Wood chisel
 - f. Folding rule
 - g. Claw hammer
 - h. Drain spade
 - i. Adjustable wrench
 - j. Pipe jaw pliers
12. (A-F) Evaluated to the satisfaction of the instructor.

UNIT II

PLASTIC PIPE AND FITTINGS

UNIT OBJECTIVE

After completing this unit, the student will be able to identify and install plastic pipe and fittings. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with plastic pipe and fittings.
2. List four types of plastic pipe and fittings.
3. Select correct statements about joining plastic pipe.
4. Identify types of PVC cements and cleaners.
5. Select correct statements about precautions of plastic pipe.
6. Demonstrate the ability to:
 - a. Install PVC fitting of PVC pipe.
 - b. Install insert fitting in PVC pipe.

UNIT II
PLASTIC PIPE AND FITTINGS

SUGGESTED ACTIVITIES

- I. Instructor:
 - A. Discuss unit objectives
 - B. Provide students with information and job sheets
 - C. Prepare transparency masters and lesson plans
 - D. Prepare a display of various PVC pipes and fittings
 - E. Give demonstrations
 - F. Give test
 - G. Review problem areas identified by test
- II. Student:
 - A. Discuss questions of unit objectives
 - B. Read and discuss information and job sheets
 - C. Complete job sheets
 - D. Take test
 - E. Discuss questions missed on test

INSTRUCTIONAL MATERIALS

- I. Included in this unit:
 - A. Objective sheet
 - B. Information sheet
 - C. Transparency masters
 - 1. II-TM-1--PVC and CPVC Fittings
 - 2. II-TM-2--Insert Fittings and Clamp
 - D. Job sheets
 - 1. Job Sheet #1--Install PVC Fitting on PVC Pipe

2. Job Sheet #2--Install Insert Fitting on PVC Pipe

E. Unit test

F. Answers to unit test

II. References:

- A. Slater, Harry. Plumbing 1. Albany, New York: Delmar Publishers. 1974.
- B. How to Design and Install Plumbing. American Technical Society. Library of Congress Number 60-1968 ISBN O-8269-0595-1.
- C. Daniels, George. Plumbing Heating and Air Conditioning. New York, New York: Popular Science Publishing Co., Harper & Row. 1972.

UNIT II
PLASTIC PIPE AND FITTINGS

INFORMATION SHEET

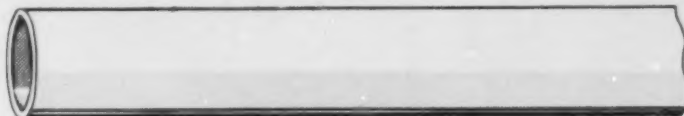
I. Terms and definitions

- A. PVC--Plastic pipe (Polyethylene Vinyl Chloride)
- B. CPVC--Plastic pipe suitable for hot or cold liquids
- C. HWP--Hot water pipe
- D. Rigid--Not to be bent
- E. Flexible--Easy to bend
- F. Belled end--End has been enlarged to serve as a coupling



BELLED END

- G. Plain end--A straight end with no bell or coupling



PLAIN END

- H. Coupled end--End of pipe has a coupling attached



COUPLED END

- I. Universal--Has more than one use
- J. Brittle--Easily cracked or broken
- K. Insert--Place inside

II. Types of plastic pipe and fittings

A. PVC 160 and PVC 200 rigid plastic pipe (PVC 160)

1. Sizes 1/2-inch through 2-inch inside diameter (I.D.)

(NOTE: I.D. sizes are 1/2, 3/4, 1, 1 1/4, 1 1/2 and 2 inches.)
2. Lengths are 20 feet with belled or coupled ends
3. Used for working pressure of 160 to 200 pounds per square inch (P.S.I.) at 73°F
4. Used for cool liquids
 - a. water
 - b. petroleum products
 - c. natural gas
5. Joints are glued

B. PVC schedule 40 rigid plastic pipe (SCH40)

1. Sizes 1/2-inch through 2-inches I.D.
2. Lengths are 20 feet with coupled ends
3. Pipe wall is thicker than PVC 160 or PVC 200
4. Used for working pressures up to 280 P.S.I. in 2-inch diameter and up to 600 P.S.I. in 1/2-inch diameter
5. Used for cool liquids
 - a. water
 - b. petroleum products
 - c. natural gas
6. Joints are glued

C. CPVC hot or cold rigid plastic pipe

1. Sizes 1/2 and 3/4 inch diameter
2. Lengths are 10 feet with plain ends
3. Has a thicker pipe wall than SCH40, PVC 160 or PVC 200

4. Used for working pressures of 100 P.S.I. at 180°
 5. Used for hot or cold liquids
 - a. water
 - b. petroleum products
 - c. others
 6. Joints are glued
- D. Polyethylene flexible plastic pipe
1. Sizes 1/2 inch through 2 inch I.D.
 2. Lengths are 100 to 300 feet rolls with plain ends
 3. Used for working pressures up to 100 P.S.I.
 4. Used for cool liquids
 - a. water
 - b. petroleum products
 - c. natural gas
 5. Joints are made with inserts and clamps

III. Joining plastic pipe and fittings (Transparency #1)

- A. The letter "C" means the PVC fitting joint is to be glued
- B. The letter "T" means the PVC fitting joint is threaded
- C. The letters "C x T" means the PVC fitting is glued on one end and threaded on the other



CxT

- D. Insert fittings and clamps (Transparency #2)
 1. Inserts can be metal or plastic

2. Inserts and clamps are used when the joint is not glued or threaded

E. Straps

1. Used to support PVC pipe
2. Should be placed at least every 48 inches
3. Used to prevent PVC pipe from sagging



IV. Cements and cleaners



A. Clear fast set PVC cement

1. Used for most PVC installation
2. Used only on pipes carrying cool liquid

B. CPVC hot line cement (HWP)

1. Used for CPVC pipe
2. Used on hot water pipe

C. Universal cement can be used for all plastic pipe

D. Universal cleaner can be used for all plastic pipe

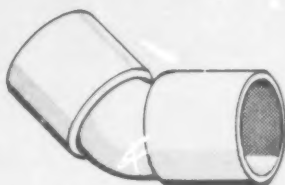
V. Precautions of plastic pipe

- A. Do not use plastic pipe to carry explosive gas or liquid under concrete slabs

- B. Plastic pipe becomes brittle if exposed to extreme cold (below 32°F) and should be insulated
- C. Always use the type of cement and cleaner recommended by the manufacturer
- D. PVC cement and cleaner should be used in a well vented area since it is toxic and highly explosive
- E. Always follow directions on the can when using PVC cement and cleaner

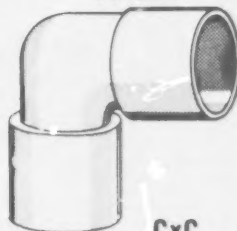
PVC AND CPVC FITTINGS

45° ELL



Cx C

90° ELL



Cx C

COUPLINGS



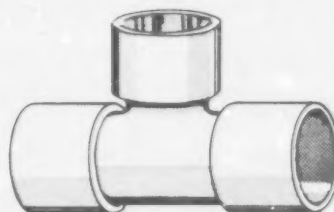
Cx C

CAPS



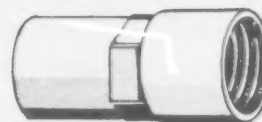
C

TEE



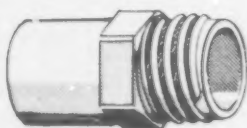
Cx Cx C

FEMALE ADAPTER



Cx T

MALE ADAPTER



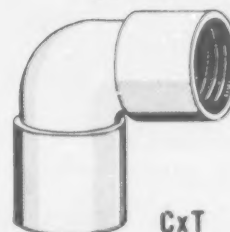
Cx T

REDUCER



Cx C

90 ELL

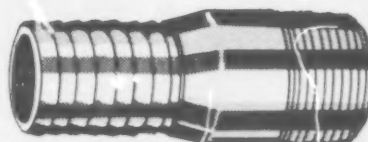


Cx T

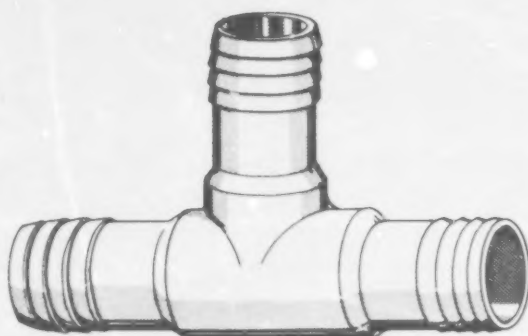
INSERT FITTINGS AND CLAMPS



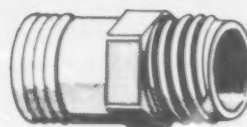
INSERT COUPLING



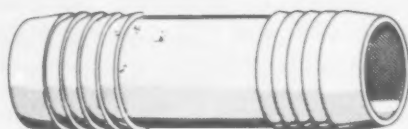
INSERT ADAPTER



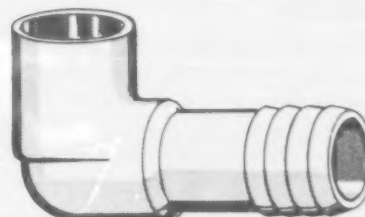
INSERT TEE



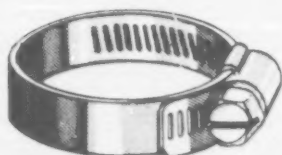
MALE INSERT COUPLING



INSERT COUPLING



INSERT ELL



LARGE CLAMP



SMALL CLAMP

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UNIT II
PLASTIC PIPE AND FITTINGS

JOB SHEET #1--INSTALL PVC FITTING ON PVC PIPE

I. Tools and materials

- A. Hacksaw
- B. Utility knife
- C. PVC pipe
- D. PVC fitting
- E. PVC cleaner
- F. PVC cement
- G. Clean, dry rag

II. Procedure

- A. Measure and cut pipe to length with hacksaw
- B. Remove all burrs from inside and outside edge of pipe with utility knife
- C. Clean area to be glued with PVC cleaner

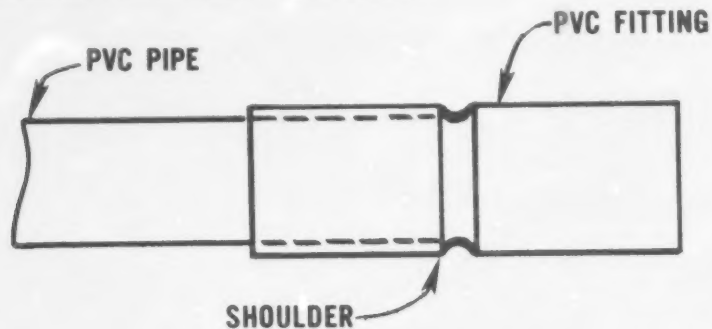
(NOTE: Fine sandpaper may also be used to clean PVC pipe but must be wiped with clean rag after sanding.)
- D. Clean inside of PVC fitting with PVC cleaner
- E. Push pipe into fitting without cement to make sure of fit

(NOTE: Pipe should go half-way into fitting.)

- F. Remove PVC pipe from fitting
- G. Apply cement to outside of pipe only with brush attached to top of cement can

(NOTE: Never apply cement to inside of fitting unless called for on the PVC cement can.)

- H. Push pipe into the fitting all the way to the shoulder and turn 1/4 turn



(NOTE: Be sure fitting is turned in the right direction since it is impossible to move when dry.)

- I. Let dry as recommended on can of PVC cement
J. Clean and store tools properly
K. Wash your hands

UNIT II

PLASTIC PIPE AND FITTINGS

JOB SHEET #2--INSTALL INSERT FITTING IN PLASTIC PIPE

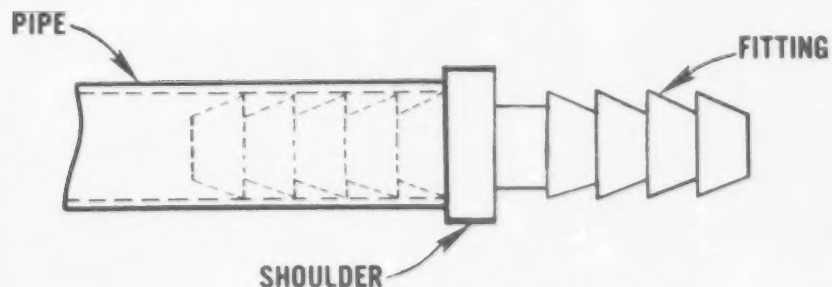
I. Tools and materials

- A. Hacksaw
- B. Utility knife
- C. Common screwdriver
- D. Plastic pipe
- E. Insert fitting
- F. Clamp

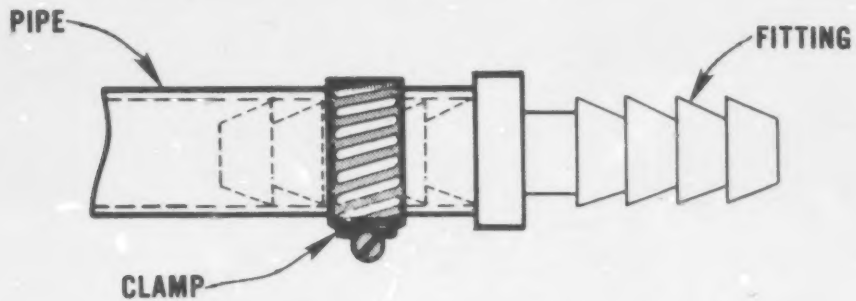
II. Procedure

- A. Measure and cut pipe to length with the hacksaw
- B. Remove burrs from inside of pipe with utility knife
- C. Place clamp loosely over pipe
- D. Insert fitting into pipe

(NOTE: Be sure fitting slides all the way to shoulder.)



- E. Move clamp to center of inserted part of fitting and tighten with the screwdriver



- F. Have instructor check your work
G. Store tools properly
H. Wash your hands

UNIT II
PLASTIC PIPE AND FITTINGS

UNIT TEST

1. Match the terms in the right hand column to the correct definition on the left. Place the number in the blank.

_____ a. End of pipe has a coupling attached	1. PVC
_____ b. Easy to bend	2. CPVC
_____ c. Not to be bent	3. HWP
_____ d. A straight end with no bell or coupling	4. Insert
_____ e. Elastic pipe suitable for hot or cold liquids	5. Rigid
_____ f. Hot water pipe	6. Brittle
_____ g. Elastic pipe	7. Flexible
_____ h. End has been enlarged to serve as a coupling	8. Plain end
_____ i. Place inside	9. Belled end
_____ j. Easily cracked or broken	10. Coupled end

2. List four types of plastic pipe and fitting.

- a.
b.
c.
d.

3. Select the correct statements about joining plastic pipe. Place a "✓" in the blank.

- _____ a. The letter "C" means the joint is to be glued.
- _____ b. The letter "T" means the joint is to be cemented.

- _____ c. The letters "CXT" mean the PVC fitting is glued on one end and threaded on the other.
 - _____ d. Insert fittings are made of metal only.
 - _____ e. Straps should be used to support PVC pipe every 48 inches.
4. Identify the correct types of PVC cements and cleaners. Place a "✓" in the blank.
- _____ a. Clear fast set PVC cement
 - _____ b. CPVC cement
 - _____ c. HVPC cement
 - _____ d. Universal cleaner
5. Select the correct statements about precautions of plastic pipe. Place a "✓" in the blank.
- _____ a. Plastic pipe may be used to carry explosive gases or liquids under a concrete slab.
 - _____ b. Plastic pipe should be insulated if it is exposed to extreme cold.
 - _____ c. All PVC cements and cleaners are used in the same manner.
 - _____ d. Use the type of cement and cleaner recommended by the manufacturer.
6. Demonstrate the ability to:
- a. Install PVC fitting on PVC pipe
 - b. Install insert fitting in PVC pipe
- (NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT II
PLASTIC PIPE AND FITTINGS

ANSWERS TO UNIT TEST

1. 10 a.
7 b.
5 c.
8 d.
2 e.
3 f.
1 g.
9 h.
4 i.
6 j.
2. a. PVC 160 or PVC 200
b. PVC schedule 40
c. CPVC
d. Flexible plastic pipe
3. ✓ a.
 b.
✓ c.
 d.
✓ e.
4. ✓ a.
✓ b.
 c.
✓ d.

5. a.

 ✓ b.

 c.

 ✓ d.

6. (a-b) Evaluated to the satisfaction of the instructor

UNIT III
DRAIN, WASTE, AND VENT LINES

UNIT OBJECTIVES

After completing this unit, the student will be able to identify pipe and fittings used in drain, waste and vent lines. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with drain, waste, and vent pipe and fittings.
2. List types of drain, waste, and vent (DWV) pipe.
3. Identify characteristics of cast iron pipe.
4. List materials used to make a joint on clay pipe.
5. Select characteristics of plastic DWV pipe.
6. Identify characteristics of galvanized steel pipe.
7. Identify copper DWV fittings.
8. Select characteristics of fiber pipe.
9. List tools used to join cast iron pipe.
10. Demonstrate the ability to:
 - a. Identify DWV materials
 - b. Make a cast iron pipe joint

UNIT III

DRAIN, WASTE, AND VENT LINES

SUGGESTED ACTIVITIES

I. Instructor:

- A. Discuss unit objectives.
- B. Provide student with information, assignment and job sheets.
- C. Prepare transparencies and lesson plans.
- D. Prepare a display of DWV materials.
- E. Plan a field trip.
- F. Give demonstrations.
- G. Give unit test.
- H. Review problem areas identified by test.

II. Student:

- A. Discuss questions of unit objectives.
- B. Read and discuss information, assignment and job sheets.
- C. Complete assignment and job sheets.
- D. Take test.
- E. Discuss questions on demonstrations and missed on test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
 - 1. III-TM-1--Cast Iron Pipe Fittings
 - 2. III-TM-2--Plastic DWV Pipe Fittings

3. III-TM-3--Galvanized Steel Fittings
 4. III-TM-4--Copper DWV Pipe Fittings
 5. III-TM-5--Fiber Pipe Fittings
- D. Assignment Sheet--Identify DWV Materials
 - E. Job Sheet--Make Cast Iron Pipe Joint
 - F. Unit test
 - G. Answers to unit test

II. References:

- A. Daniels, George. Plumbing, Heating and Air Conditioning. New York, New York: Popular Science Publishing Co., Harper and Row. 1972.
- B. Slater, Harry. Plumbing 1. Albany, New York: Delmar Publisher. 1974.

UNIT III

DRAIN, WASTE, AND VENT LINES

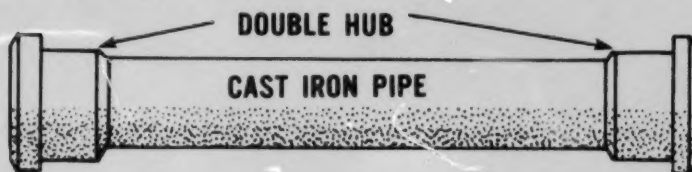
INFORMATION SHEET

I. Terms and definitions

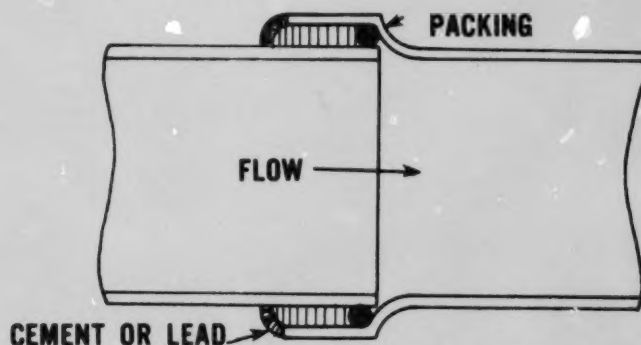
- A. Lead--A metal melted to make a water tight seal in cast iron pipe
- B. Hub--Bell-shaped joint on end of cast iron pipe
- C. Single hub--Hub on one end of cast iron pipe



- D. Double hub--Hub on both ends of cast iron pipe

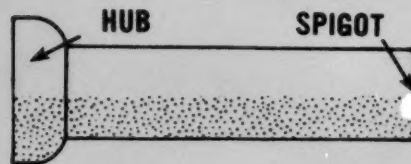


- E. Packing--A seal made at the joint of cast iron or clay pipe

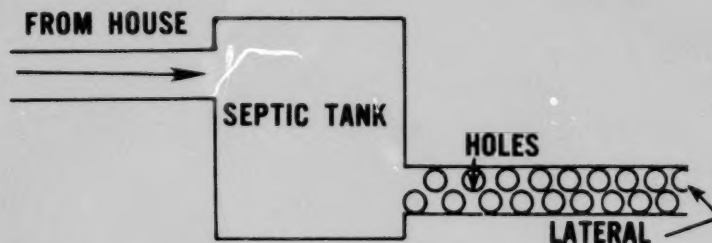


- F. Jute--A fiber used to make a packing
(NOTE: The same fiber used to make hemp rope.)
- G. Oakum--Jute that has been treated in tar and used for packing

- H. Spigot--The plain end of a length of pipe usually not threaded



- I. Main--A large sewer, water, or gas pipe that serves many houses
- J. DWV--Drain-waste-vent
- K. Perforated--Has holes punched in a regular pattern
- L. Adaptor--A fitting used to join two pipes of different diameters
- M. Soil pipe--Large pipes used to carry sewage
- N. Durability--Long lasting
- O. Laterals--Pipe or lines that drain septic tanks



II. Types of DWV pipe

- A. Cast iron
- B. Clay
- C. Plastic
- D. Galvanized steel
- E. Copper
- F. Fiber

III. Cast iron pipe and fittings (Transparency #1)

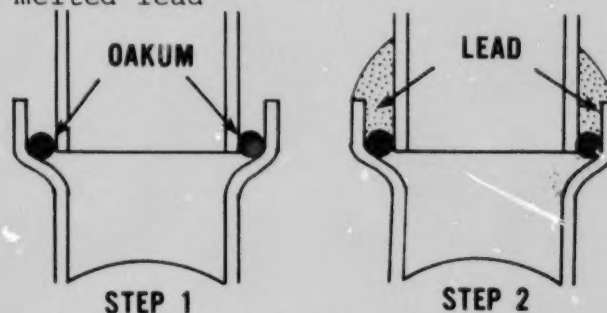
A. Sizes

1. Two, three, and four inch I.D.
2. Five and ten foot lengths

B. Single hub or double hub

C. Used for drains in bathrooms, kitchens, laundries and fixtures where quality is important

D. Joined by tamping oakum into the joint and pouring in melted lead



E. Used for high quality and durability

F. Used under buildings, slabs and as drain lines to mains

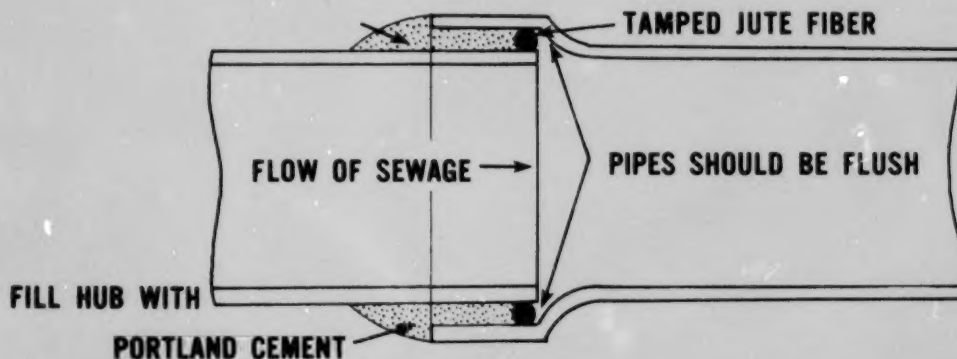
IV. Clay soil pipe

A. Sizes

1. Two and six-inch I.D.
2. Two and four-foot lengths

B. Used for drain lines from house to sewer main

C. Joined by tamping oakum into the joint and filling with portland cement



V. Plastic DWV pipe (Transparency #2)

A. Sizes

1. 1 1/2 to 4 inches I.D.
2. Lengths up to 20 feet

- B. Used for drain lines from house to main
- C. Perforated plastic DWV is used for lateral lines on septic tanks
- D. Joined by using PVC glue
- E. Easy to install, economical, and long lasting

VI. Galvanized steel pipe (Transparency #3)

- A. Same as galvanized water pipe
- B. Sizes are various lengths and diameters
- C. Joined with threaded, black, or galvanized cast fittings
- D. Used for durability

VII. Copper DWV pipe (Transparency #4)

A. Sizes

1. 1 1/2 to 4 inches I.D.
2. Twenty-foot lengths

- B. Used in residential and commercial drainage plumbing
- C. Joined by sweat solder joints
- D. High quality and easy installation

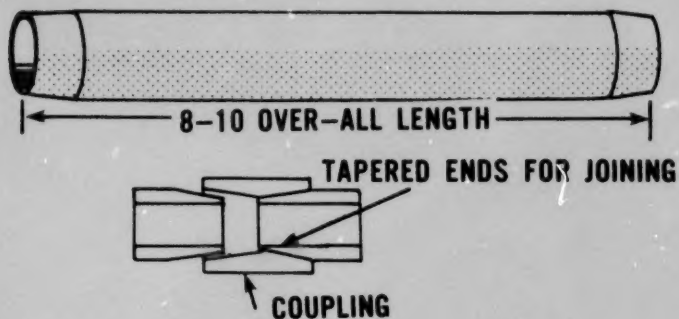
VIII. Fiber pipe (Transparency #5)

(NOTE: Fiber pipe is sometimes called Orangeburg pipe.)

A. Sizes

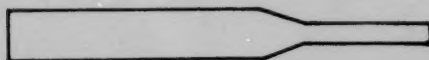
1. Two, four and six-inch diameters
2. Eight-and ten-foot lengths

- B. Used for drain lines from house to mains
- C. Perforated fiber pipe is used for laterals on septic tanks
- D. Joined by tapered friction fittings

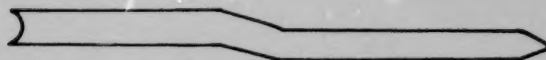


IX. Tools used to join cast iron pipe

- A. Melting pot and ladle
- B. Burner for melting pot
- C. Hacksaw
- D. Cold chisel
- E. Hammer
- F. Yarning iron



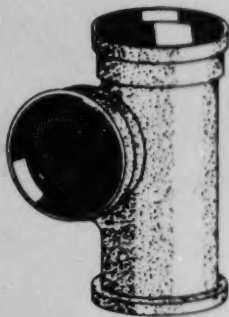
- G. Offset caulking iron



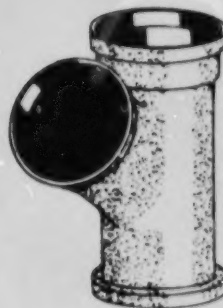
CAST IRON PIPE FITTING

III-11

SANITARY TEE



SANITARY Y



SANITARY CROSS



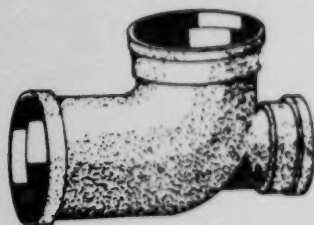
TEE WITH 90 DEGREE INLET



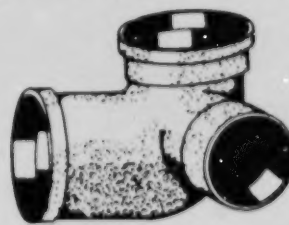
COMBINATION Y AND 1/8 BEND



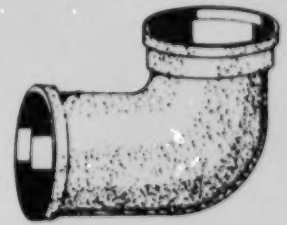
QUARTER BEND WITH HEEL INLET



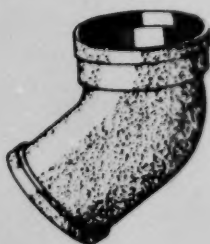
QUARTER BEND WITH SIDE INLET



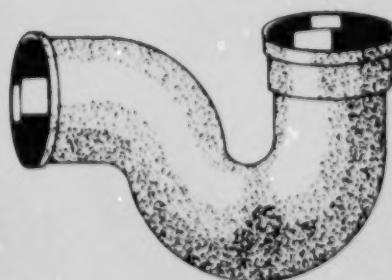
90° QUARTER BEND



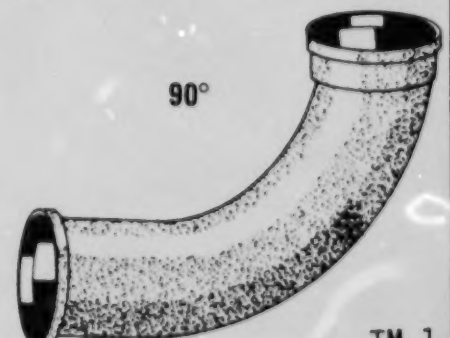
45° EIGHTH BEND



P TRAP



LONG SWEEP QUARTER BEND

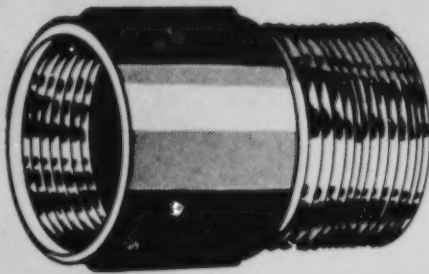


TM-1

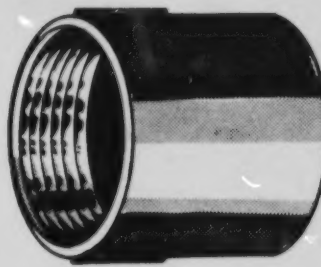
PLASTIC DWV PIPE FITTING

III-13

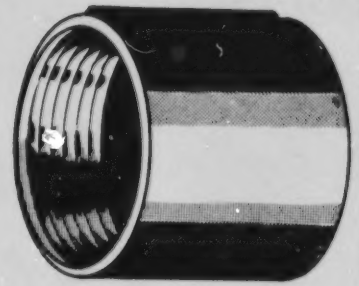
MALE ADAPTER



FEMALE ADAPTER



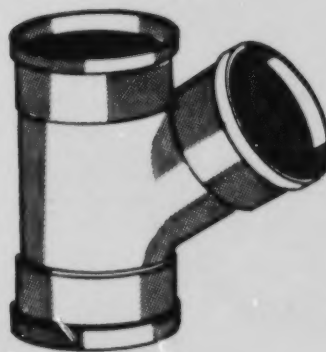
COUPLING



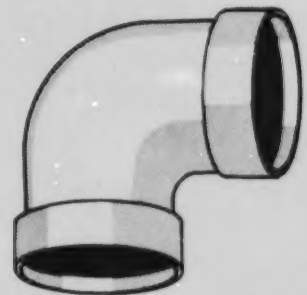
SANITARY TEE 90° ANGLE



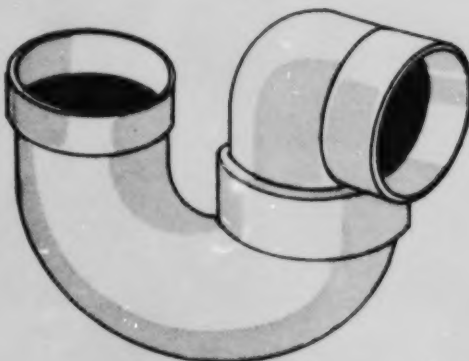
SANITARY WYE 45°



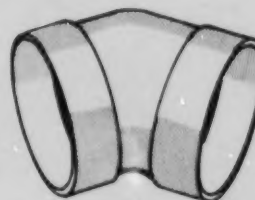
1/4 BEND



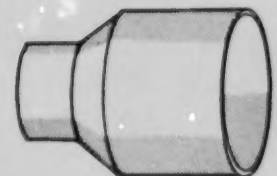
P TRAP



1/8 BEND

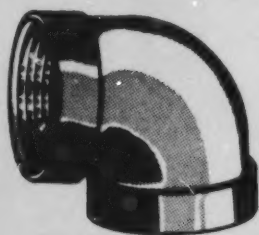


ADAPTER

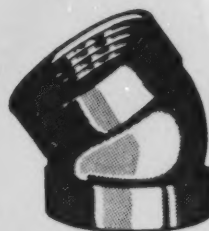


GALVANIZED STEEL FITTINGS

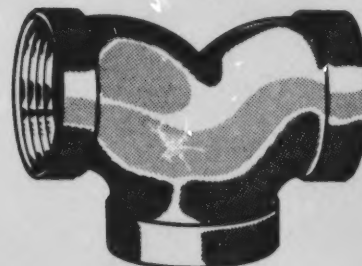
90° BEND



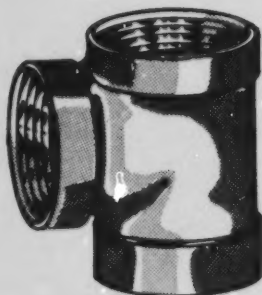
45° BEND



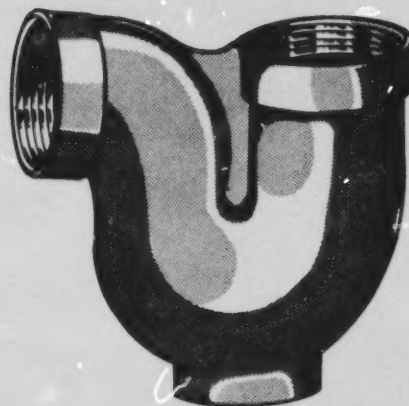
90° THREE-WAY BEND



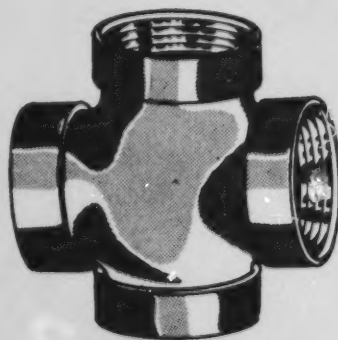
90° TEE



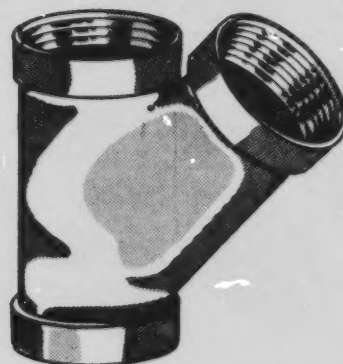
P TRAPS



45° SHORT TURN WYE



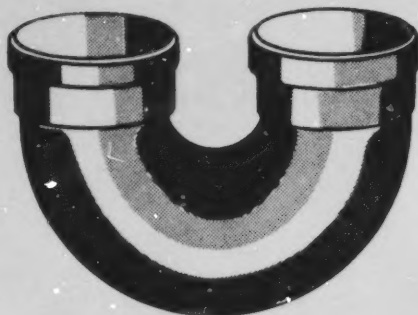
90° DOUBLE T-Y



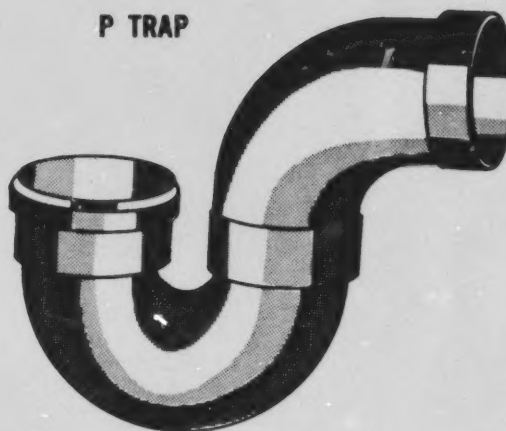
COPPER DWV PIPE FITTING

III-17

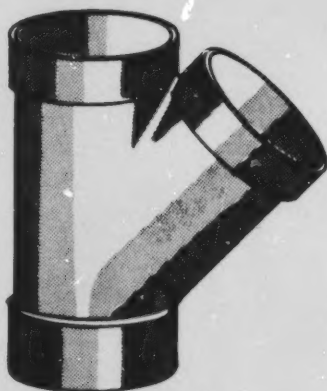
RETURN BEND



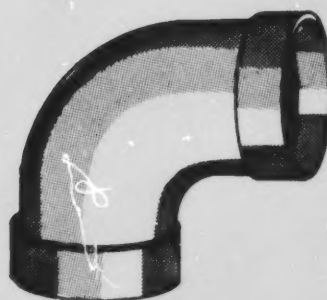
P TRAP



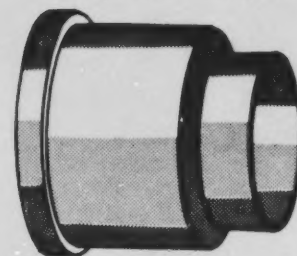
45° Y-BRANCH



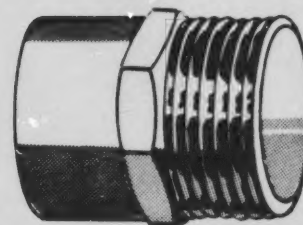
90° BEND



SOIL PIPE ADAPTER



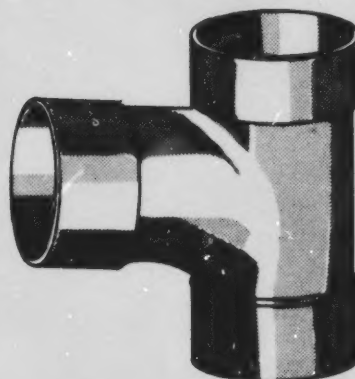
ADAPTER



45° BEND



90° SANITARY TEE



CLEAN-OUT

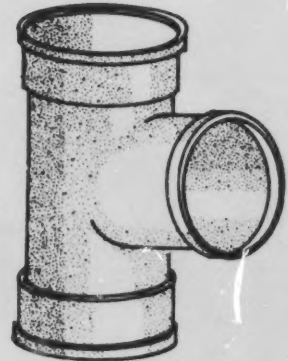


FIBER PIPE FITTINGS

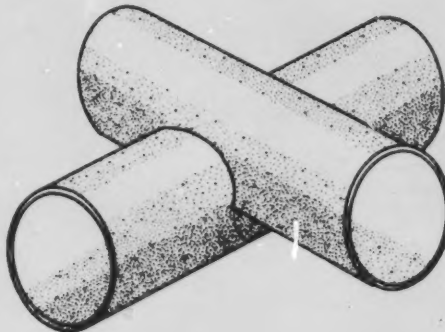
T-BRANCH



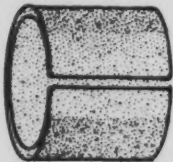
TEE



CROSS



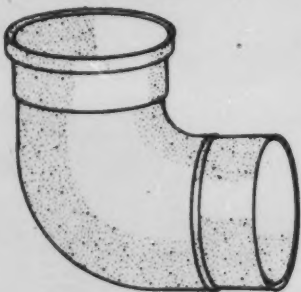
SNAP COUPLING



COUPLING



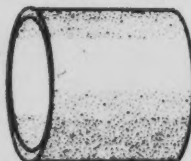
1/4-BEND



1/8-BEND



CAST-IRON PIPE ADAPTER



JOINING SLEEVE



UNIT III

DRAIN, WASTE AND VENT LINES

ASSIGNMENT SHEET--IDENTIFY DWV MATERIALS

Directions: The instructor will prepare a display of the DWV pipe and fittings covered in Parts III through Part VIII of the information sheet. Each item will be assigned a number. On a sheet of paper, write the name of each item beside the number of that item.

(NOTE: The instructor may provide a list of DWV pipe and fitting terms from which you can select your answer.)

UNIT III
DRAIN, WASTE AND VENT LINES

JOB SHEET--MAKE CAST IRON PIPE JOINT

I. Tools and materials

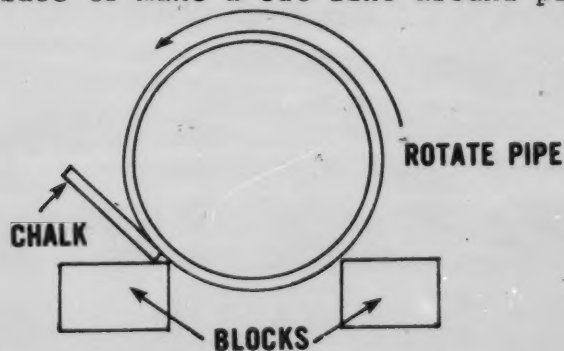
- A. Melting pot and ladle
- B. Burner for melting pot
- C. Hacksaw
- D. Cold chisel
- E. Hammer
- F. Yarning iron
- G. Offset caulking iron
- H. Oakum
- I. Lead
- J. Cast iron pipe (two lengths of single hub)

II. Procedure

- A. Place lead in pot and light burner

(NOTE: Lead should be melted first so it is ready to pour when joint is prepared.)

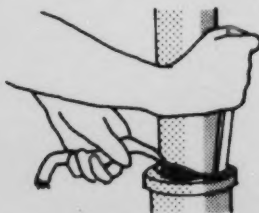
- B. Measure length to be cut
- C. Nail two blocks of wood to work bench about 2 inches apart
- D. Lay pipe between blocks and rotate, holding chalk in place to make a cut line around pipe



- E. Cut pipe about 1/16 inch deep all around pipe with hacksaw
- F. Rotate pipe while tapping end with hammer until end of pipe snaps off
- G. If pipe is extra heavy, tap cold chisel into hacksaw cut all around pipe until end of pipe snaps off.



- H. Place cut end into hub end of other pipe squarely
- I. Push oakum into hub tightly using yarning iron



- J. Pour molten lead into joint on top of oakum
- K. Allow lead to cool
- L. Tap caulking iron into cooled lead to force it against pipe surfaces to seal joint



- M. Have instructor check your work
- N. Clean and store tools properly
- O. Wash your hands

UNIT III

DRAIN, WASTE AND VENT LINES

UNIT TEST

1. Match the terms in the right hand column to the correct definition on the left. Place the number in the blank.

_____ a.	Bell shaped joint on end of cast iron pipe	1. Packing
_____ b.	Metal used to make a seal on cast iron joint	2. Main
_____ c.	A seal made at the joint of cast iron or clay pipe	3. Lead
_____ d.	Jute treated in tar and used for packing	4. Oakum
_____ e.	Drain, Waste, Vent	5. Hub
_____ f.	Large sewer, water or gas pipe serving many houses	6. DWV
_____ g.	Plain end of pipe usually not threaded	7. Spigot
_____ h.	Holes punched in a regular pattern	8. Perforated

2. List four of the six types of DWV pipe.

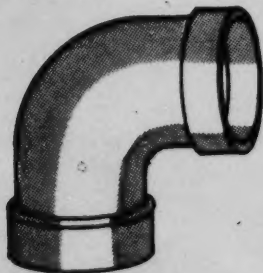
- a. _____
- b. _____
- c. _____
- d. _____

3. Identify the correct statements about cast iron pipe. Place a "✓" in the blank.

- _____ a. Single hub or double hub
- _____ b. 20-foot lengths
- _____ c. Used for high pressure lines
- _____ d. Joined with oakum and lead

- _____ e. High quality and durability
- _____ f. Used under slabs
- 4. List two materials used to make a joint on clay pipe.
 - a. _____
 - b. _____
- 5. Select the true statements about plastic DWV pipe. Place a "✓" in the blank.
 - _____ a. Lengths up to 20 feet
 - _____ b. Used to carry explosive gases under pressure
 - _____ c. Perforated plastic DWV is used for lateral lines
 - _____ d. Expensive and highest quality
 - _____ e. Joined with melted lead
- 6. Identify the correct statements about galvanized steel pipe. Place a "✓" in the blank.
 - _____ a. Galvanized DWV pipe is the same as galvanized water pipe
 - _____ b. Joints are made with threaded, black or galvanized cast fittings
- 7. Identify the copper DWV pipe fittings. Choose your answer from the list below. Write your answer in the blank.

"P" trap
90° bend

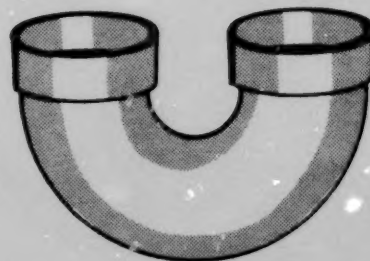
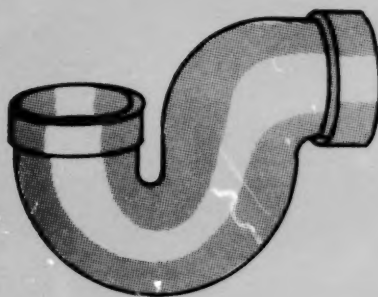


a. _____

Sanitary tee
Return bend



b. _____



c. _____

d. _____

8. Select the true statements about fiber pipe. Place a "✓" in the blank.

- _____ a. Two, four and six-inch diameters
 _____ b. Used for drain lines
 _____ c. Perforated fiber pipe is used for pressure lines
 _____ d. Joints are made using glue

9. List five tools used to join cast iron pipe.

- a. _____
 b. _____
 c. _____
 d. _____
 e. _____

10. Demonstrate the ability to:

- a. Identify DWV materials
 b. Make cast iron pipe joint

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT III

DRAIN, WASTE AND VENT LINES

ANSWERS TO UNIT TEST

1. 3 a.
 5 b.
 1 c.
 4 d.
 6 e.
 2 f.
 7 g.
 8 h.
2. Any of these six:
 - a. Cast iron
 - b. Clay
 - c. Plastic
 - d. Galvanized steel
 - e. Copper
 - f. Fiber
3. ✓ a.
 b.
 c.
 ✓ d.
 ✓ e.
 ✓ f.
4. a. Oakum
 b. Cement

5. ☒ a.
☐ b.
☒ c.
☐ d.
☐ e.
6. ☒ a.
☒ b.
7. a. 90° bend
b. Sanitary tee
c. Return bend
d. "P" trap
8. ☒ a.
☒ b.
☐ c.
☐ d.
9. Any of these seven:
a. Melting pot and ladle
b. Burner
c. Hacksaw
d. Cold chisel
e. Hammer
f. Yarning iron
g. Offset caulking iron
10. (a-b) Evaluated to the satisfaction of the instructor.

UNIT IV
PIPE JOINTS, ANGLES, AND FLOW

UNIT OBJECTIVE

After completing this unit, the student will be able to identify pipe joints and install correct angles for proper flow of drain lines. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with pipe joints, angles, and flow.
2. Measure the angle of fittings.
3. Identify threaded steel pipe fittings.
4. Select the characteristics of steel pipe joints.
5. Identify cast iron soil pipe fittings.
6. Determine the characteristics of angles, branches and flow.
7. Determine the entry angle of drain lines to sewer main.
8. List types of straps and hangers.
9. Demonstrate the ability to:
 - a. Measure the angles of steel pipe fittings.
 - b. Install a fitting on steel pipe.
 - c. Set slope of drain line.

UNIT IV

PIPE JOINTS, ANGLES, AND FLOW

SUGGESTED ACTIVITIES

I. Instructor:

- A. Discuss unit objectives.
- B. Provide students with Information, Assignment and Job sheets.
- C. Prepare transparencies and lesson plans.
- D. Prepare area to lay drain line.
- E. Give test.
- F. Review problem areas identified by test.

II. Student

- A. Discuss questions of unit objectives.
- B. Read and discuss Information, Assignment, and Job sheets.
- C. Complete Assignment and Job sheets.
- D. Take test
- E. Discuss questions missed on test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
 - 1. IV-TM-1--Cast Iron Soil Pipe Bends
 - 2. IV-TM-2--Drain and Sewer Connections
 - 3. IV-TM-3--Setting Slope of Drain Line
 - 4. IV-TM-4--Types of Pipe Straps and Hangers

- D. Assignment Sheet--Measure Angles of Steel Pipe Fittings
- E. Job sheets
 - 1. Job Sheet #1--Install a Fitting On Steel Pipe
 - 2. Job Sheet #2--Set Slope of Drain Line
- F. Unit test
- G. Answers to unit test

II. References:

- A. Slater, Harry. Plumbing 1. Albany, New York: Delmar Publishers. 1974.
- B. Daniels, George. Plumbing Heating and Air Conditioning. New York: Popular Science Publishing Co., Harper & Row. 1972.

UNIT IV
PIPE JOINTS, ANGLES, AND FLOW

INFORMATION SHEET

I. Terms and definitions

- A. Pipe joint compound--Used to seal threaded pipe joints

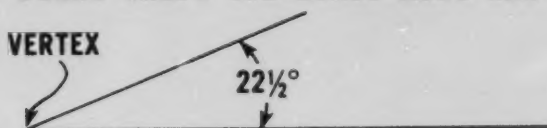
(Note: Also called "pipe dope.")

- B. Fitting bead--Rim of pipe fitting where pipe wrench should be attached



- C. Protractor--Used to measure angles

- D. Vertex--Point where two lines meet and cross



- E. Sewage--Solid and liquid waste

- F. Branch--A place in a pipe where two or more pipes come together

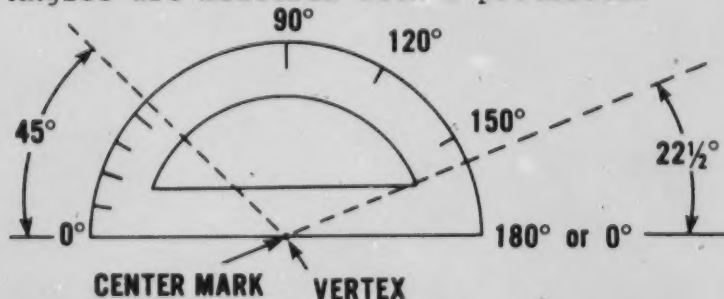
- G. Expansion--Pulling apart

- H. Contraction--Pushing together

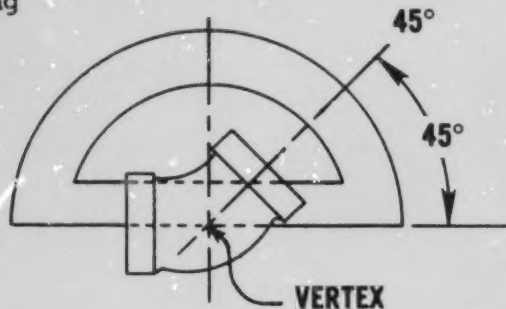
II. Angle measurements of fittings

- A. Length of lines do not effect size of angle

- B. Angles are measured with a protractor



- C. Base of protractor is parallel to center line of fitting at one end
- D. Angle is measured at centerline of other end of fitting

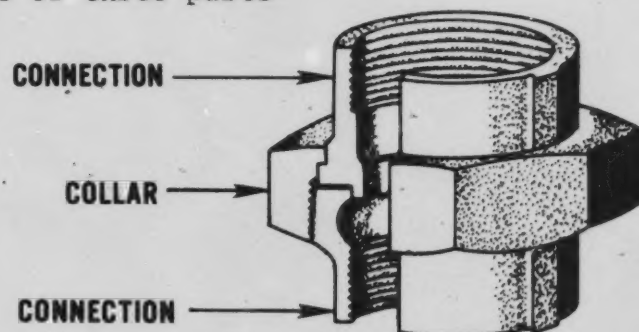


(Note: Vertex of protractor is placed on center of fitting.)

III. Threaded steel pipe fittings

A. Union

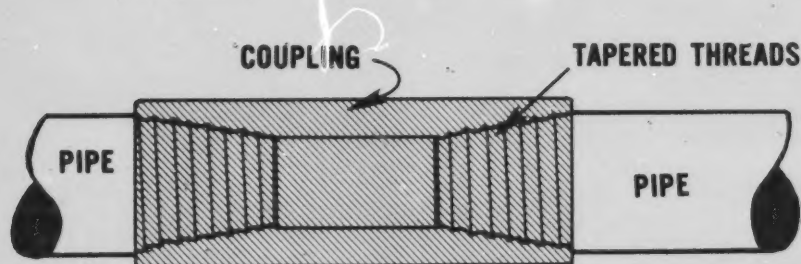
- 1. Used to join two pipes that cannot be turned
- 2. Used to connect two pipes that must be disconnected frequently
- 3. Consists of three parts



B. Coupling

- 1. Joins two pipes when at least one pipe will turn
- 2. Used when it is unlikely the pipe will be disconnected
- 3. Used to extend length of pipe

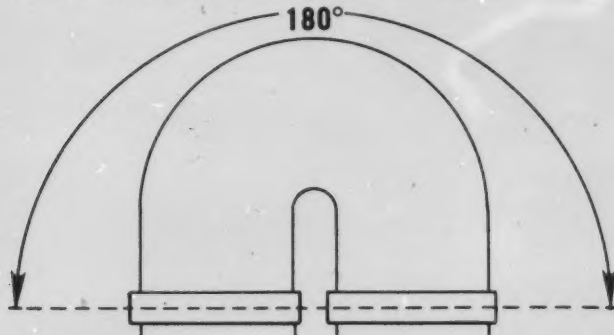
4. Bends in a pipe should never be made near a coupling



- C. Elbows--A fitting that changes the direction of a pipe.

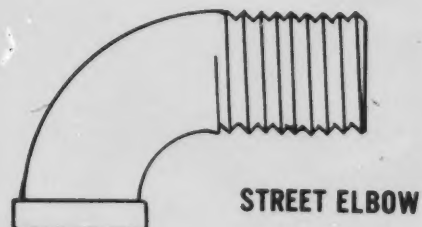
(Note: An elbow is also called an "ell" or "bend.")

1. 180° return elbow or "U-bend"

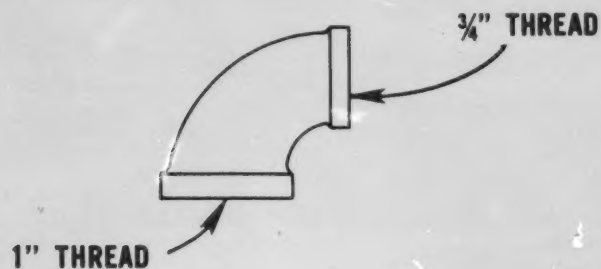


(Note: Most direction changes of pipe are 90° or 45°.)

2. Street elbow--Connects a male and female pipe end



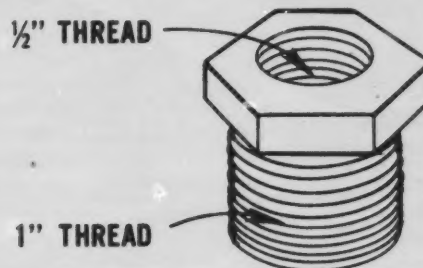
3. Reducer elbow--Connects two pipes of different diameters and changes direction



- D. Reducers--Connects two pipes of different diameters but does not change pipe direction

1. Bushing

- a. Used to reduce outlets
- b. Made in a variety of sizes
- c. Large threads on male end and smaller threads on female end



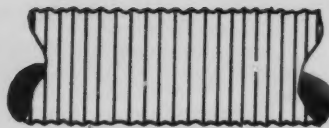
2. Coupling

- a. Made in a variety of sizes
- b. Both ends are female



E. Nipples

1. Made from galvanized pipe, black pipe, or brass pipe
2. Inside diameters are standard on all types of pipe
3. Lengths of 1/2 inch to 12 inches
4. Threads
 - a. Close or all thread
 - b. Shoulder



CLOSE OR ALL THREAD



SHOULDER

IV. Steel pipe joints

- A. Threads should be clean and undamaged
- B. Pipe joint compound should be used on every joint
- C. Fittings are screwed on hand tight and turned 1 to 2 turns with pipe wrench
- D. Pipe wrench sizes used
 1. Up to 10 inch wrench for 1/8" to 1/2" pipe
 2. 14 inch wrench for 3/4" to 1" pipe
 3. 18 inch wrench for 1 1/4" to 1 1/2" pipe
 4. 24 inch wrench for 2" pipe
- E. Use a pipe vise to hold pipe while using pipe wrench

(Note: If pipe vise is not available, use two pipe wrenches close together turned in opposite directions.)

V. Cast iron soil pipe fittings

A. Bend (Transparency #1)

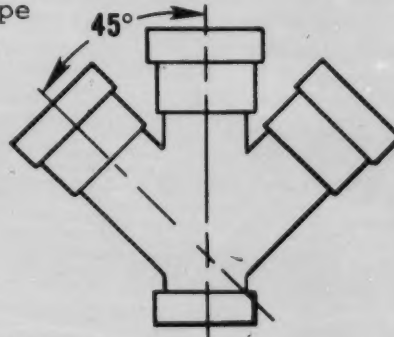
1. Used to change direction of soil pipe
2. Degrees of angles
 - a. quarter bend - 90°
 - b. eighth bend - 45°
3. The longer sweep bends have less resistance to the flow of water

(Note: Regular quarter bends should be used on vents only since the short turn may block sewage and clog the drain.)

4. Three kinds of bends
 - a. regular quarter bend
 - b. short sweep quarter bend
 - c. long sweep quarter bend

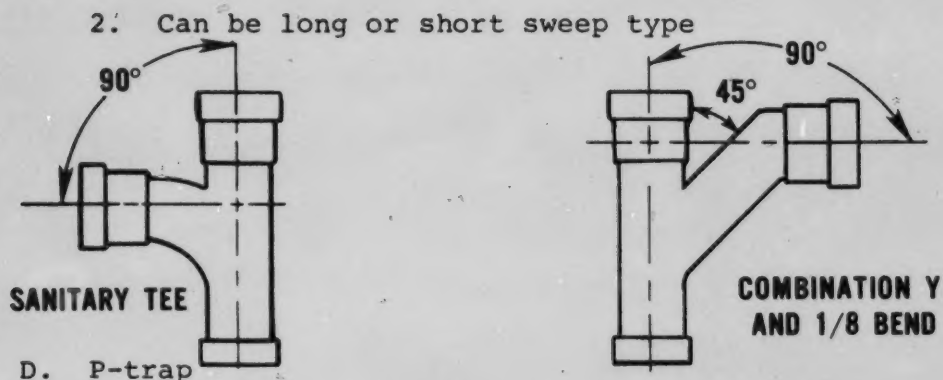
B. Double V-branch

1. The 45° allows sewage to flow easily through the pipe without clogging
2. Used where branches are made at 45° on one or both sides of the pipe

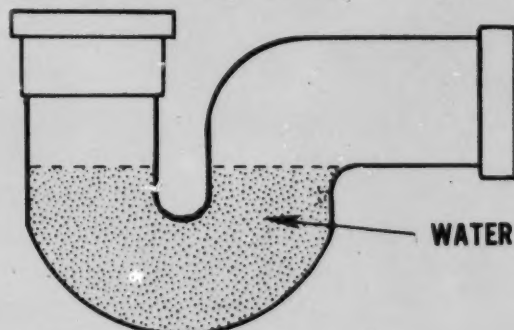


C. Sanitary tee and combination Y

1. Used where branches are made at 90° on one or both sides of the pipe

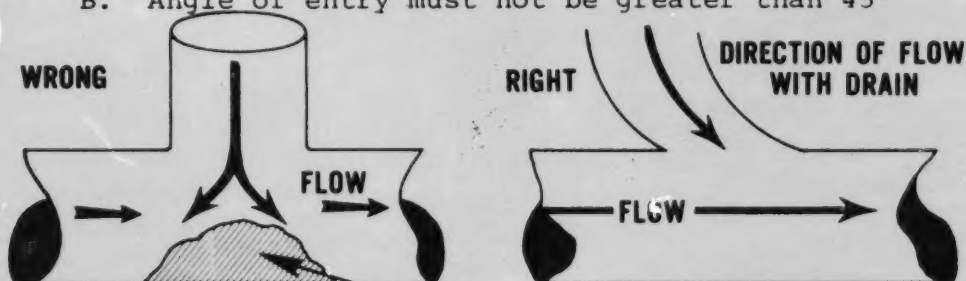


1. Placed in a drain pipe to prevent sewer gas and odor from backing up into building
2. Does not resist the flow of sewage
3. Water stands in trap to make a gas and odor seal



VI. Angles of branches and flow

- A. Sewage flow of branches must be in same direction as drain line
- B. Angle of entry must not be greater than 45°



SEWAGE COLLECTS HERE

- C. Direction change in drain lines are made in the same way as branch lines
- D. 90° long sweep bends may be used for horizontal

turns or change of drain line direction

VII. Drain and sewer connections (Transparency #2)

- A. Drain line carries sewage from building to sewer main or septic tank
- B. Check local regulations before choosing material for drain lines
- C. Joints must line up evenly with the excess cement removed from the inside
- D. Drain line should slope $1/4$ to $1/2$ inch per foot toward sewer main (Transparency #3)
- E. Drain line should enter sewer main at 45° angle

VIII. Pipe hangers and straps

- A. Pipe hangers are used to support pipes both horizontal and vertical
- B. Considerations when selecting pipe hangers
 - 1. Weight of pipe
 - 2. Expansion and contraction of pipe
 - 3. Vibration
- C. Types of straps and hangers (Transparency #4)
 - 1. Reznor hook
 - 2. Pipe strap
 - 3. Perforated strap iron
 - 4. Clevis hanger

CAST IRON PIPE BENDS

fig. 1

**REGULAR QUARTER BEND 90°**

fig. 2

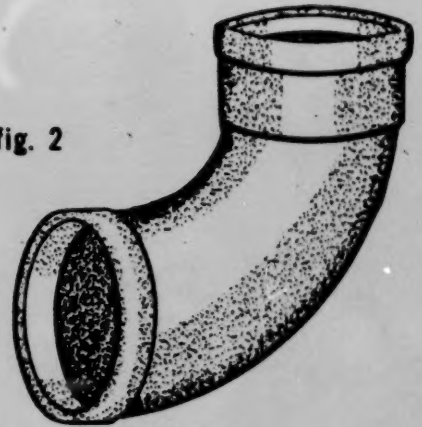
**SHORT SWEEP QUARTER BEND 90°**

fig. 3

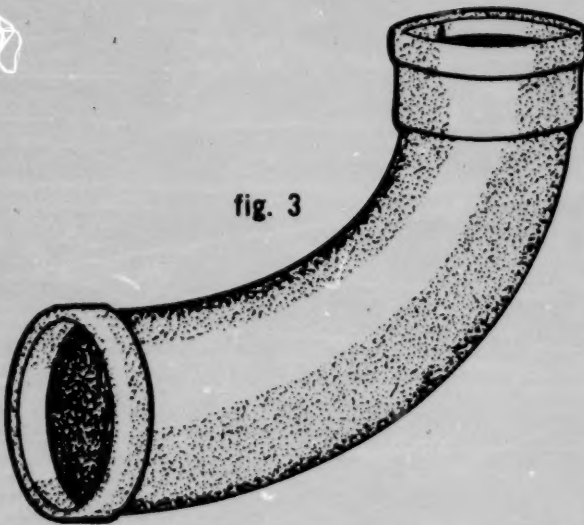
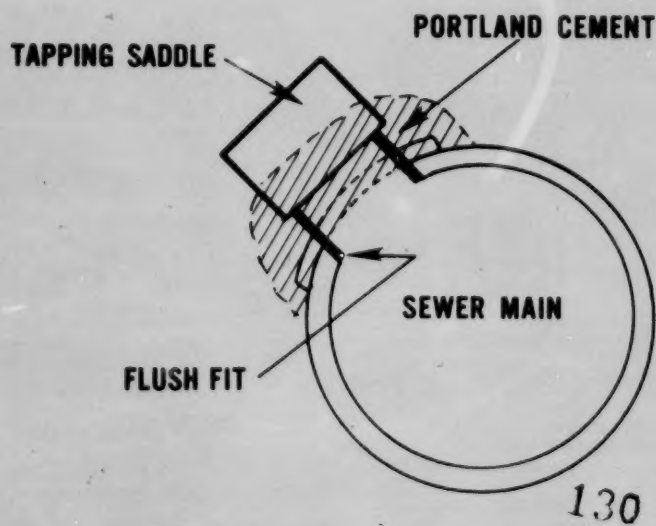
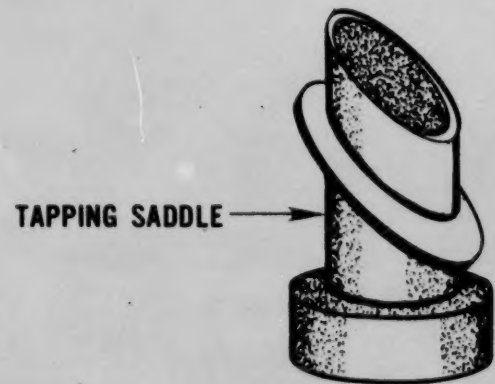
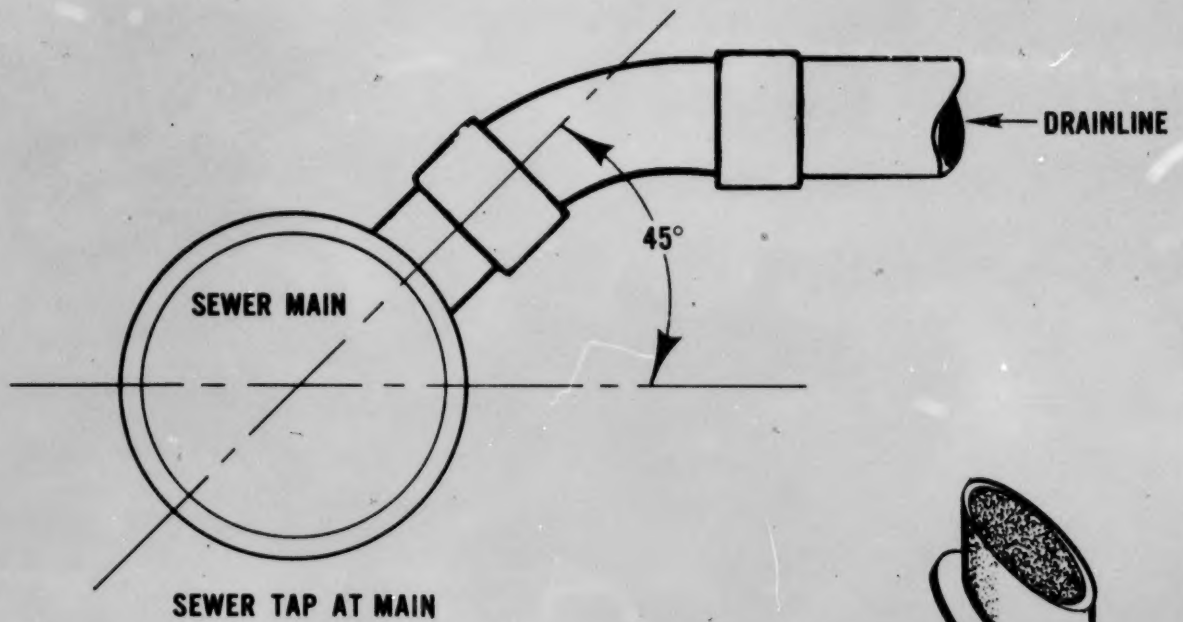
**LONG SWEEP QUARTER BEND 90°**

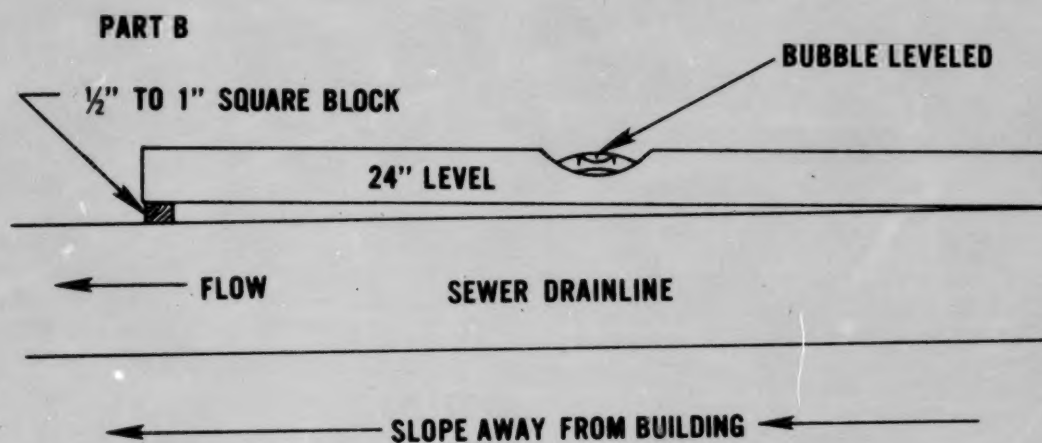
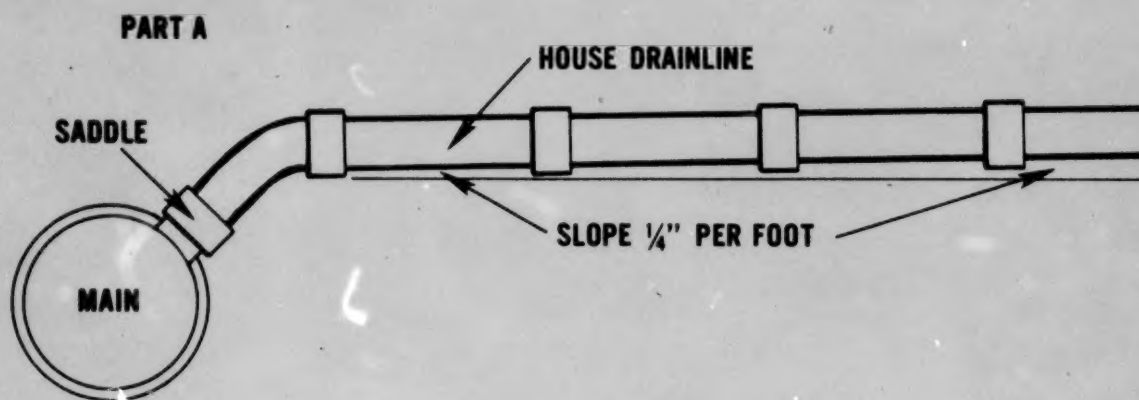
fig. 4

**EIGHTH BEND 45°**

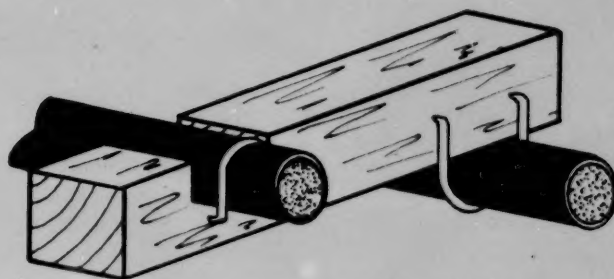
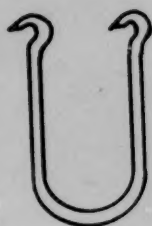
DRAIN AND SEWER CONNECTIONS



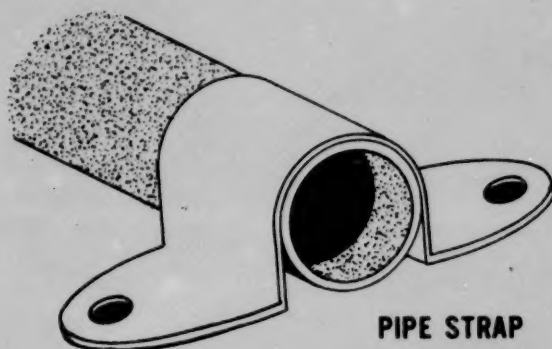
SETTING SLOPE OF DRAIN LINE



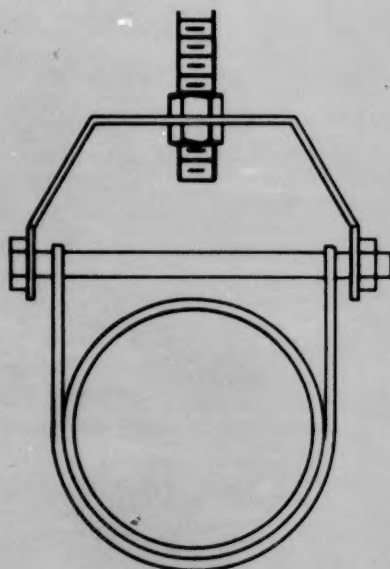
TYPES OF PIPE STRAPS AND HANGERS



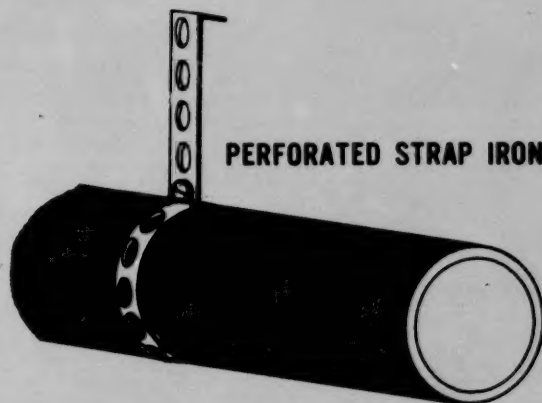
WIRE PIPE HOOKS (REZNOR)



PIPE STRAP



CLEVIS HANGER



PERFORATED STRAP IRON

UNIT IV

PIPE JOINTS, ANGLES, AND FLOW

ASSIGNMENT SHEET--MEASURE ANGLES OF STEEL PIPE FITTINGS

Directions: The instructor will prepare an assortment of various size and angle steel pipe fittings. A number will be assigned to each fitting. Using a protractor and Part II of the Information Sheet, determine the angle of each fitting. Write your answer on a sheet of paper beside the number of each fitting.

UNIT IV
PIPE JOINTS, ANGLES, AND FLOW

JOB SHEET #1--INSTALL A FITTING ON STEEL PIPE

I. Tools and materials

- A. Pipe vise
- B. Pipe wrench
- C. 3/4 inch steel pipe coupling
- D. 3/4 inch threaded steel pipe
- E. Pipe joint compound

II. Procedure

- A. Inspect threads on pipe and inside coupling for dirt or damage.
- B. Place pipe in vise with threaded end 2 to 4 inches away from vise.
- C. Spread pipe joint compound on pipe threads.
(Note: Be sure to spread compound all the way around threads.)
- D. Screw coupling onto pipe hand tight.
- E. Place pipe wrench on coupling and adjust wrench so the coupling fits snug in bottom of wrench jaws.
- F. Turn the coupling one to two turns in a clockwise direction.

(Note: If wrench slips on pipe, turn it over to make it grip.)

UNIT IV

PIPE JOINTS, ANGLES, AND FLOW

JOB SHEET #2--SET SLOPE OF DRAIN LINE

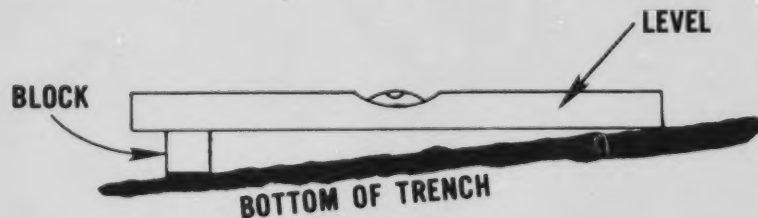
I. Tools and materials

- A. 24 inch level
- B. 1/2-inch to 1 inch wood block
- C. Four-foot length of drain pipe
- D. Shovel
- E. Location to lay drain pipe

(NOTE: If a location is not available, the instructor may prepare a box filled with soil.)

II. Procedure

- A. Determine the depth the pipe is to be laid.
- B. Using the shovel, dig a trench in which to lay the pipe.
- C. Place the wood block in the bottom of the trench and place one end of the level on the block and the other on the bottom of the trench.



- D. Check level bubble for slope of trench.
- E. Lay pipe in trench.
- F. Check slope of pipe using the same procedure as in Step C.
- G. When bubble is in middle of level glass, slope is correct.
- H. Have instructor check your work.

UNIT IV

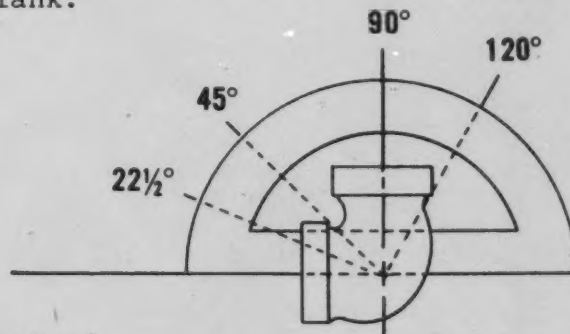
PIPE JOINTS, ANGLES, AND FLOW

UNIT TEST

1. Match the terms in the right hand column to the correct definition on the left. Place the number in the blank.

- | | |
|--|------------------------|
| ___ a. Used to measure angles | 1. Sewage |
| ___ b. Solid and liquid waste | 2. Branch |
| ___ c. Point where two lines meet and cross | 3. Fitting bead |
| ___ d. Used to seal threaded pipe joints | 4. Pipe joint compound |
| ___ e. Rim of pipe fitting where wrench is attached | 5. Expansion |
| ___ f. Pulling apart | 6. Contraction |
| ___ g. Pushing together | 7. Vertex |
| ___ h. A place in a pipe where two or more pipes come together | 8. Protractor |

2. Determine the angle of the fitting below. Write your answer in the blank.

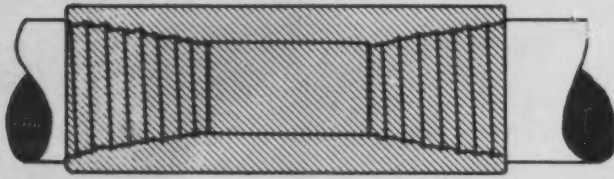


_____ degree bend

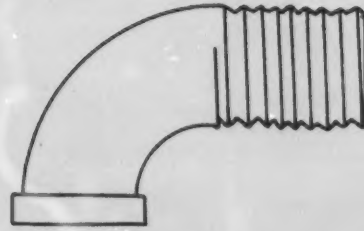
3. Identify the threaded steel pipe fittings. Choose your answer from the list below. Write your answer in the blank.

union
coupling
street elbow

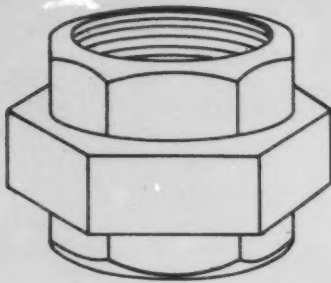
reducer coupling
nipple
reducing elbow



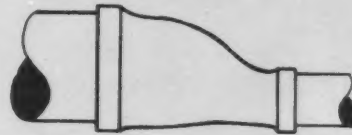
a. _____



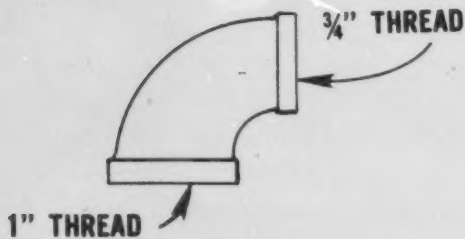
b. _____



c. _____



d. _____



e. _____



f. _____

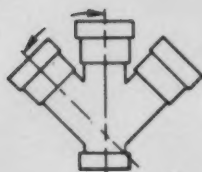
4. Select the true statements about steel pipe joints.
Place a "✓" in the blank.

- ____ a. Threads should be clean and undamaged.
- ____ b. Pipe joint compound should be used if the joint leaks.
- ____ c. The diameter of a pipe determines the size of pipe wrench to be used.
- ____ d. Threaded steel pipe settings are screwed on hand tight and then 4 turns with a pipe wrench.

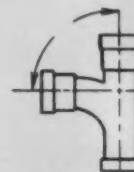
5. Identify the cast iron soil pipe fittings. Choose your answer from the list below. Write your answer in the blank.

P-trap
Sanitary tee

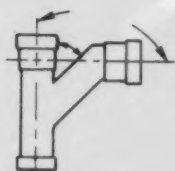
Combination Y and 1/8 bend
Double Y-branch



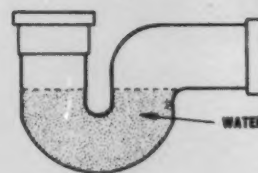
a. _____



b. _____



c. _____

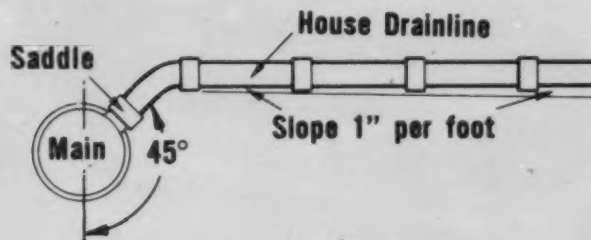


d. _____

6. Select the true statements about angles of branches and flow. Place a "✓" in the blank.

- ____ a. The angle of entry of a branch must not be greater than 45°.
- ____ b. 90° long sweep bends may be used for horizontal turns.
- ____ c. 90° long sweep bends may not be used for change of direction of drain lines.
- ____ d. Change of direction in drain lines and branch lines are made the same way.

7. Determine if the angle of entry into the sewer main and the slope of the drain line is correct. Place a "✓" in two of the four boxes below.



- a. Entry angle
☐ correct
☐ incorrect
- b. Slope
☐ correct
☐ incorrect
8. List three types of straps and hangers.
- a. _____
- b. _____
- c. _____
9. Demonstrate the ability to:
- a. Measure angles of steel pipe fittings.
- b. Install a fitting on steel pipe.
- c. Set slope of drain line.

(Note: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT IV
PIPE JOINTS, ANGLES, AND FLOW

ANSWERS TO UNIT TEST

1. 8 a.
1 b.
7 c.
4 d.
3 e.
5 f.
6 g.
2 h.
2. 90°
3. a. coupling
b. street elbow
c. union
d. reducer coupling
e. reducer elbow
f. nipple
4. ✓ a.
 b. used on all joints
✓ c.
 d. 1 to 2 turns
5. a. Double Y-branch
b. Sanitary tee
c. Combination Y and 1/8 bend
d. P-trap

6. ✓ a.

✓ b.

 c.

✓ d.

7. a. correct

b. incorrect

8. Any 3 of these 4

a. Reznor hook

b. Pipe strap

c. Perforated strap iron

d. Clevis hanger

9. (a-c) Evaluated to the satisfaction of the instructor

UNIT V
FIXTURES AND VALVES

UNIT OBJECTIVE

After completing this unit, the student will be able to identify plumbing fixtures and valves and install a bathroom lavatory. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with plumbing fixtures and valves.
2. Select the characteristics of kitchen sinks.
3. Select the characteristics of bathroom lavatories.
4. List types of hangers used for lavatories and sinks.
5. Select the characteristics of bathtubs.
6. Select the characteristics of water closets.
7. List types of valves.
8. List types of bibbs and cocks.
9. Identify architectural plumbing symbols.
10. Identify plumbing fixtures and valves.
11. Demonstrate the ability to install a bathroom lavatory.

UNIT V
FIXTURES AND VALVES

SUGGESTED ACTIVITIES

- I. Instructor:
 - A. Discuss unit objectives
 - B. Provide students with Information, Assignment, and Job Sheets
 - C. Prepare transparencies
 - D. Prepare material needed for Assignment and Job Sheet
 - E. Give test
 - F. Review problem areas identified by test
- II. Student:
 - A. Discuss questions on unit objectives
 - B. Read and discuss Information, Assignment, and Job Sheets
 - C. Complete Assignment and Job Sheets
 - D. Take test
 - E. Review questions missed on test.

INSTRUCTIONAL MATERIALS

- I. Included in this unit:
 - A. Objective sheet
 - B. Information Sheet
 - C. Transparency masters
 - 1. V-TM-1--Types of Kitchen Sinks
 - 2. V-TM-2--Types of Kitchen Sink Faucets
 - 3. V-TM-3a--Kitchen Sink Drains and Fittings

4. V-TM-3b--Kitchen Sink Drains and Fittings
5. V-TM-4--Assembly of Kitchen Sink
6. V-TM-7--Assembly of Bathroom Lavatory
7. V-TM-5--Types of Bathroom Lavatories
8. V-TM-6--Types of Lavatory Drains
9. V-TM-8--Types of Bathtubs
10. V-TM-9--Types of Bathtub Faucets
11. V-TM-10--Bathtub Drains and Fittings
12. V-TM-11--Assembly of Bathtub
13. V-TM-12--Water Closet
14. V-TM-13--Types of Valves
15. V-TM-13b--Types of Valves
16. V-TM-14--Valve Cutaways
17. V-TM-15--Types of Bibbs and Cocks
18. V-TM-16--Architectural Plumbing Symbols
- D. Assignment Sheet--Identify Fixtures and Valves
- E. Job Sheet--Install a Bathroom Lavatory
- F. Unit Test
- G. Answers to unit test

II. References:

- A. Slater, Harry. Plumbing 1. Albany, New York: Delmar Publishers, 1974.
- B. Slater, Harry. Plumbing 2. Albany, New York: Delmar Publishers, 1975.

UNIT V
FIXTURES AND VALVES

INFORMATION SHEET

I. Terms and definitions

- A. Fixture--Something built into place for a specific use

Examples: sink, bathtub, or lavatory

- B. Valve--A device used to control the flow of gas or liquid

- C. Faucet--A type of valve

- D. Enamel--Baked-on finish that gives a glossy appearance

- E. P.O. Plug--Patent overflow plug

- F. Diverter--A device that switches the direction of flow

- G. Water Closet--Bathroom commode

- H. Elongated--The length of an object is greater than the width

- I. Vitreous--Glossy, slick surface

- J. Bibb--A faucet with a bent-over spout.

II. Kitchen sinks

- A. Types (Transparency #1)

1. Single compartment

a. flat rim

b. ledge rim

2. Double compartment

a. flat rim

b. ledge rim

B. Materials

1. Vitreous china--Made of very fine clay and finished with a glassy, slick surface
2. Pressed steel--Sheet steel that is pressed to shape
3. Cast iron

C. Finishes--The material of which the surface is made

1. Stainless steel
2. White enamel
3. Colored enamel

D. Types of faucets (Transparency #2)

1. Deck--Mounted on sink
 - a. Single handle
 - b. Double handle
2. Wall--Mounted on wall
 - a. Single handle
 - b. Double handle
3. Dish-sprays

E. Drains and fittings (Transparency #3a & b)

1. Supplies--Cold and hot water lines
2. Strainers
 - a. Flat top
 - b. Basket
3. Continuous waste
 - a. End outlet
 - b. Center Outlet

4. Traps

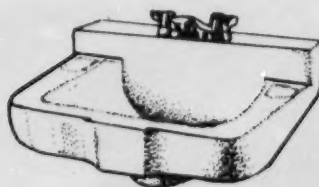
- a. P-trap
- b. S-trap

F. Assembly of kitchen sink (Transparency #4)

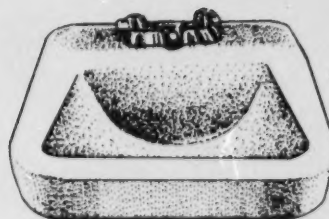
III. Bathroom lavatories

A. Types (Transparency #5)

- 1. Countertop
 - a. Round
 - b. Rectangular
 - c. Oval
 - d. Three-sided
- 2. Wall hung
 - a. Ledge back



b. Flat back



B. Materials

1. Vitreous china
2. Pressed steel
3. Cast Iron

C. Finishes

1. Stainless steel
2. White enamel
3. Colored enamel

D. Types of faucets

1. Single handle



2. Double handle



E. Drains and fittings

1. Types of drains (Transparency #6)
 - a. Chain stopper and P.O. plug
 - b. Pop-up

2. Traps--(Use the same as for kitchen sinks)

a. P-trap

b. S-trap

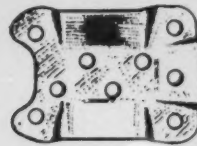
3. Supplies--Cold and hot water lines

F. Assembly of bathroom lavatory (Transparency #7)

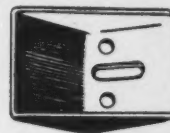
IV. Sink and lavatory fasteners

A. Types of hangers--Used to support the sink or lavatory

1. Universal--Fits most fixtures



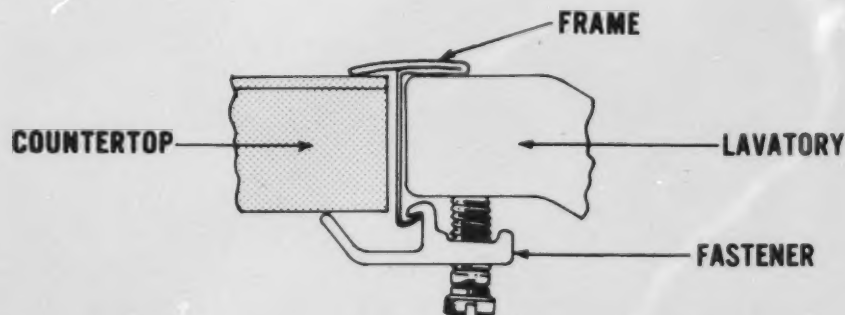
2. China fixtures



3. Steel and cast iron



B. Fastener frame--Used to clamp the fixture to the countertop



V. Bathtubs

A. Types (Transparency #8)

1. Recess--Enclosed by walls at both ends and back
2. Corner--Enclosed by wall at one end and back
3. Freestanding--Away from the walls

B. Materials

1. Steel
2. Cast iron

C. Finishes

1. White enamel
2. Colored enamel

D. Tub faucets (Transparency #9)

1. Single handle
2. Single handle with shower
3. Double handle
4. Double handle with shower

E. Bathtub drains and fittings (Transparency #10)

1. Waste and overflow with trip lever
2. Waste and overflow with chain stopper
3. Rough brass P-trap
4. Drum trap with bottom cleanout

F. Assembly of bathtub (Transparency #11)

VI. Water closet (Transparency #12)

A. Types

1. Washdown--Water enters bowl from around the rim
2. Syphon jet--Water enters bowl from around the rim and below water level line

(NOTE: Both types come in round bowl, shallow bowl and elongated bowl.)

B. Materials--Made of vitreous china

C. Finishes

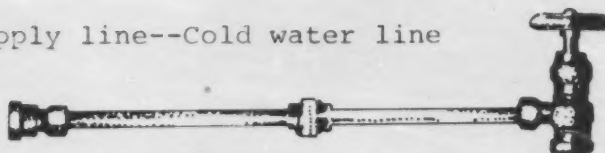
1. White enamel
2. Colored enamel

D. Trim and Connections

1. Seat and cover



2. Supply line--Cold water line



3. Types of floor seals

- a. Wax
- b. Sponge rubber
- c. Plastic

PLASTIC



WAX



SPONGE RUBBER



E. Styles

1. Wall-hung--Tank hung on wall
2. Closed-coupled--Tank mounted on bowl
3. One-piece--Tank and bowl are molded as one piece
4. Vacuum flush
 - a. Has no tank
 - b. Water enters bowl through a vacuum flush valve
 - c. Used in public building

VII. Types of valves (Transparencies #13a & 13b)

A. Gate

(NOTE: Gate valves are also called stop valves.)

1. Should be used only in the "open" or "closed" position
2. Will chatter and vibrate if only partially closed
3. Made with both rising and nonrising stems
4. Used for water, gas, steam or oil

B. Globe

1. May be used in open , closed or partially closed position
2. May be repacked at the stem
3. Used to regulate flow
4. Four types: (Transparency #14)
 - a. Conventional disc
 - b. Composition disc
 - c. Needle-valve type
 - d. Plug-valve type

C. Compression

1. Similar to a globe valve but used for lighter duty
2. Used in most residential buildings
3. Made in sizes 3/8, 1/2, and 3/4 inch diameter inlets
4. Can be made for threaded or sweat solder joints

D. Ball--Used as a stop valve

E. Check

1. Prevent flow of gas or fluids in the wrong direction
2. Two basic types
 - a. Swing check
 - b. Lift check
3. Sizes 1/8 inch to 2 inches made of brass
4. Sizes 3 inch to 6 inch made of cast iron

F. Stop and waste--Used on water lines

G. Tube connector--Used with copper tubing

H. Gas stop--Used on gas service line

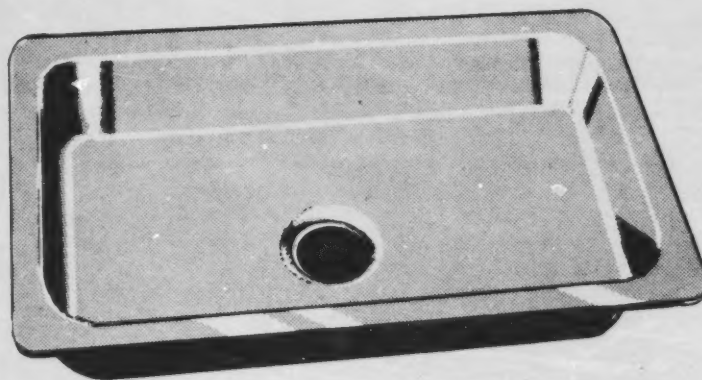
VIII. Types of bibbs and cocks (Transparency #15)

- A. Hose bibb-- Has threaded spout for hose connection
- B. Plain bibb--Used to supply water to lavatories
- C. Sill cock--Used for water supply on outside walls
- D. Boiler Cock--Used on water heaters
- E. Special sill cock--Has threaded outlet for evaporative cooler line

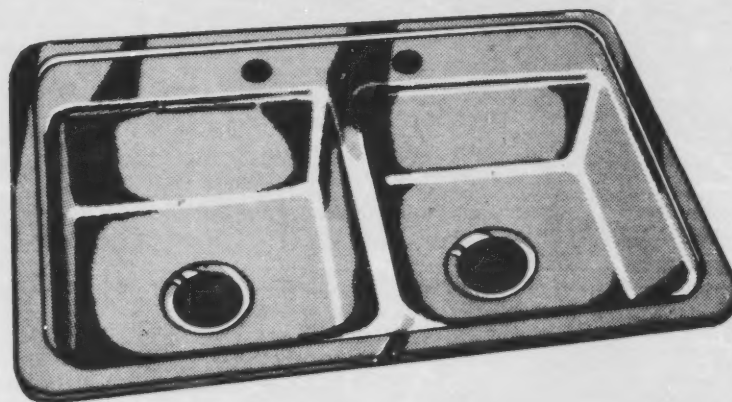
IX. Architectural plumbing symbols (Transparency #16)

- A. Used to locate fixtures and appliances on blue-print
- B. Can be done free style or use template

TYPES OF KITCHEN SINKS

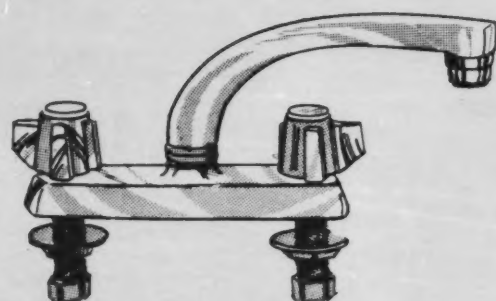


SINGLE COMPARTMENT-FLAT RIM



DOUBLE COMPARTMENT-LEDGE RIM

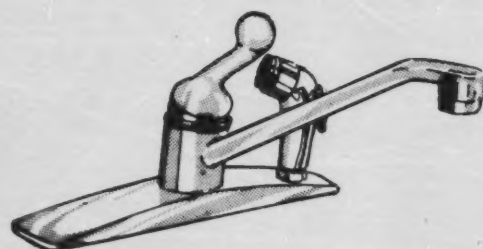
TYPES OF KITCHEN SINK FAUCETS



DOUBLE HANDLE DECK



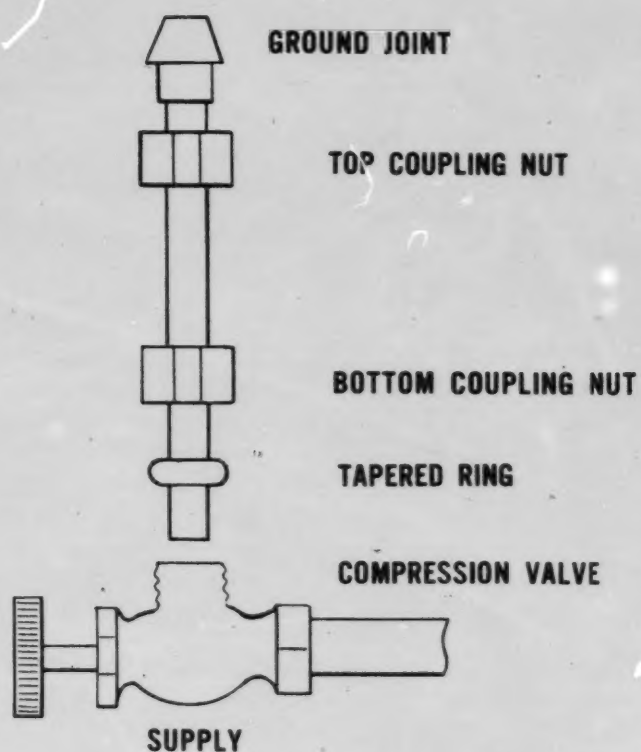
DOUBLE HANDLE WALL



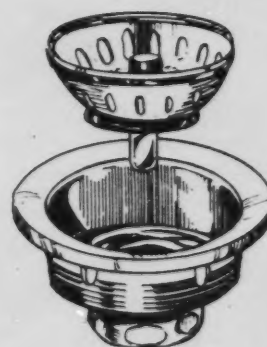
SINGLE HANDLE DECK
WITH DISH-SPRAY



KITCHEN SINK DRAINS AND FITTINGS



FLAT TOP

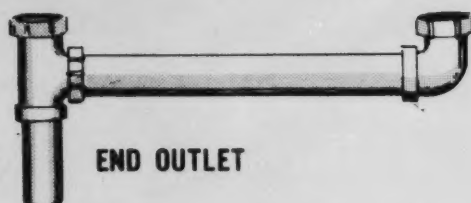


BASKET

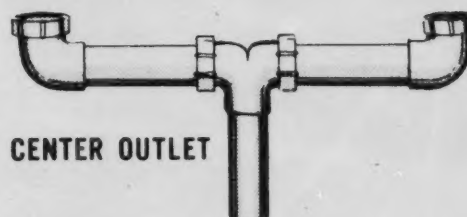
STRAINERS

KITCHEN SINK DRAINS AND FITTINGS

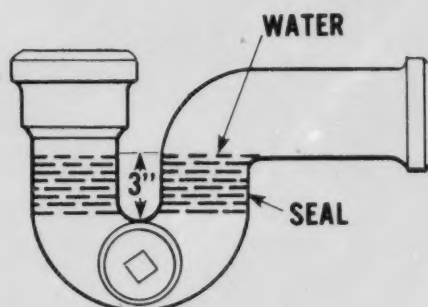
CONTINUOUS WASTE



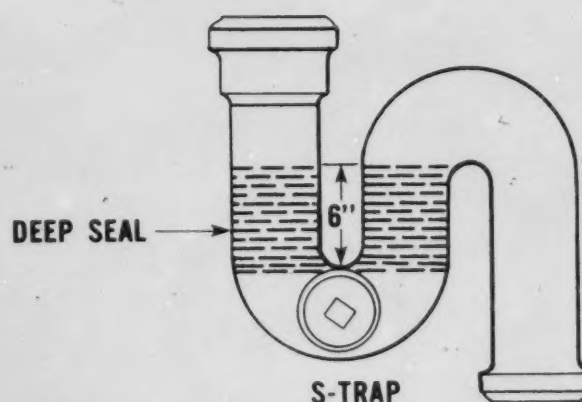
END OUTLET



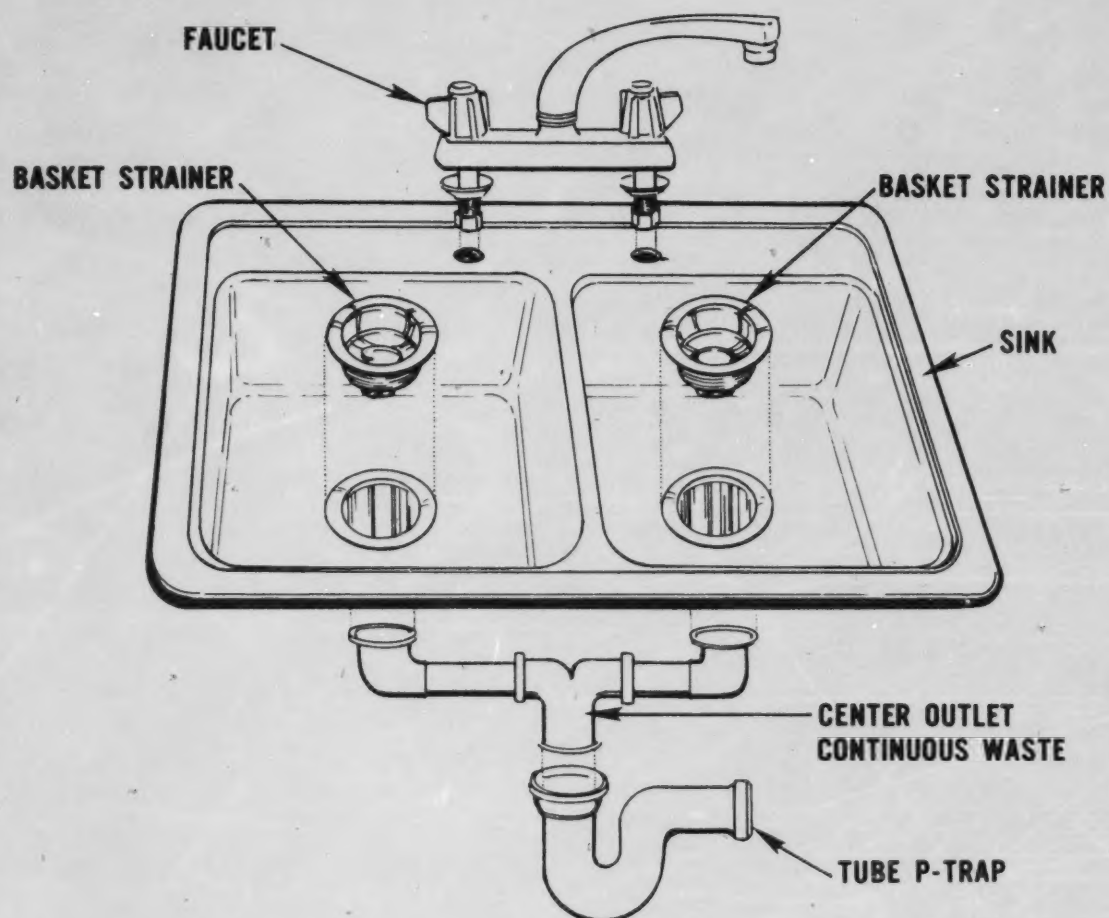
CENTER OUTLET



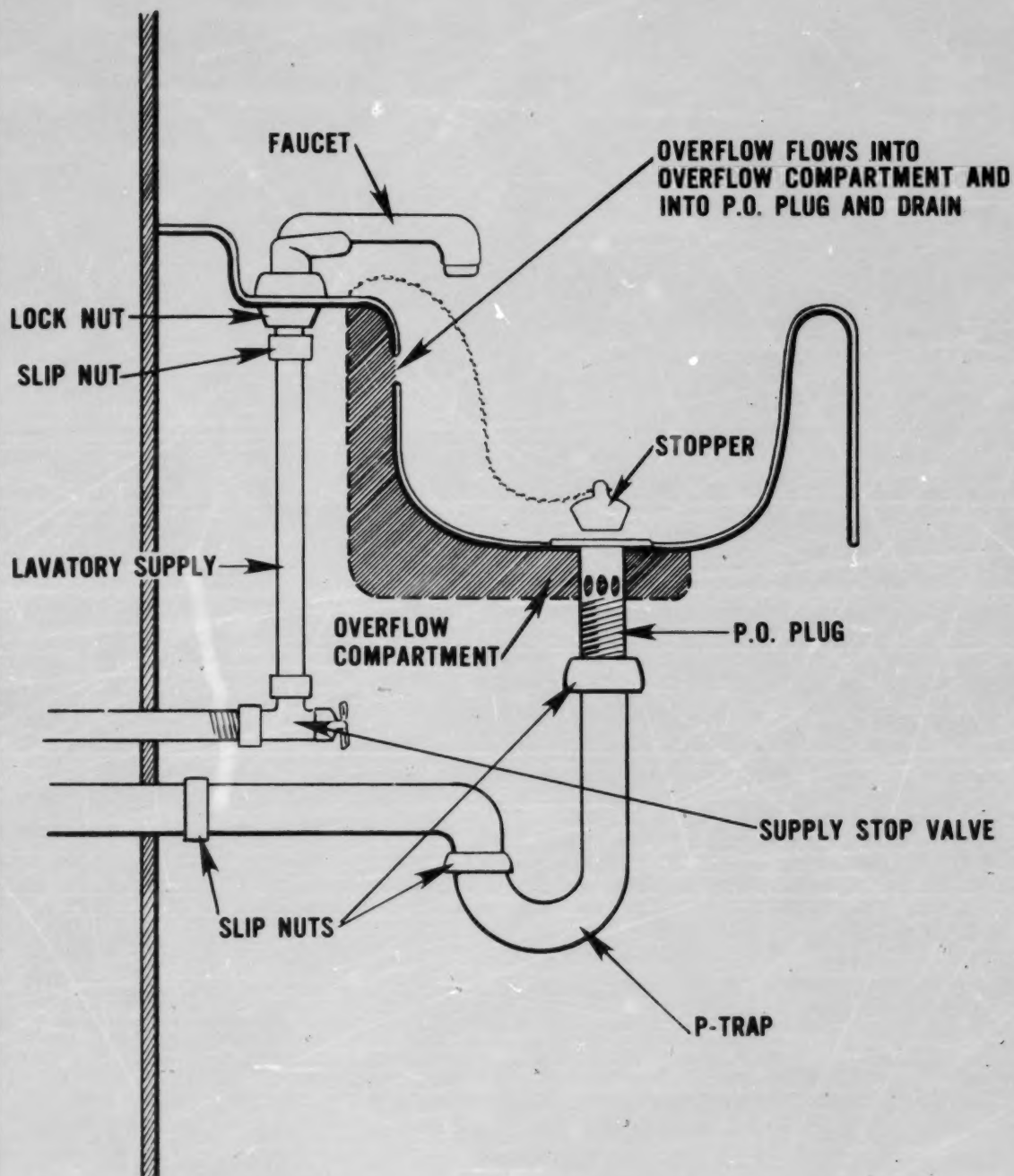
P-TRAP



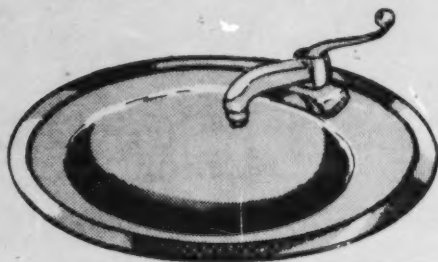
ASSEMBLY OF KITCHEN SINK



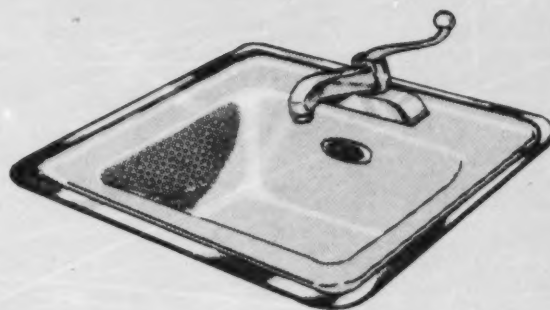
ASSEMBLY OF BATHROOM LAVATORY



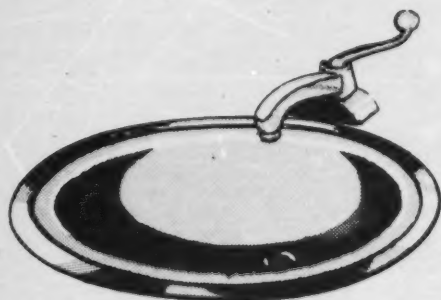
TYPES OF BATHROOM LAVATORIES



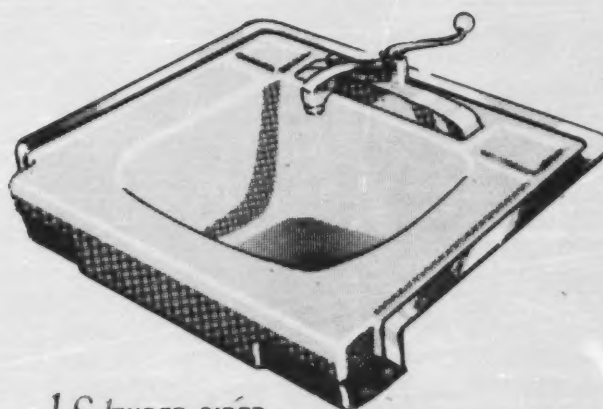
ROUND



RECTANGULAR



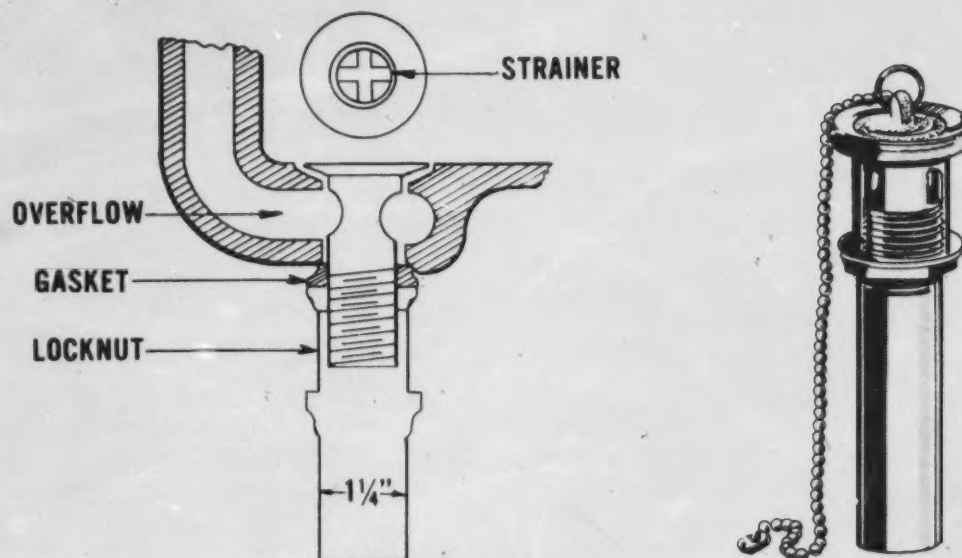
OVAL



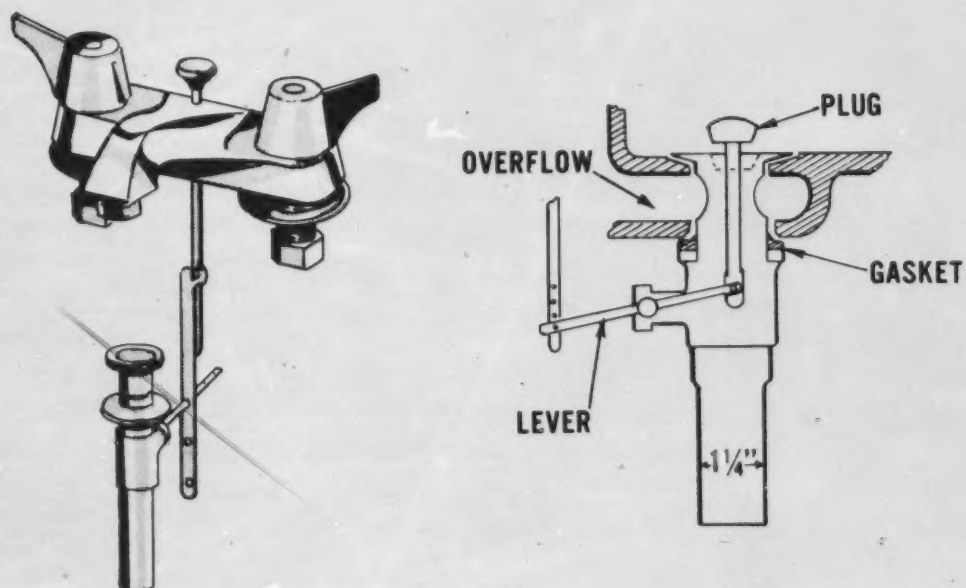
161 THREE SIDED

TM-6

TYPES OF LAVATORY DRAINS

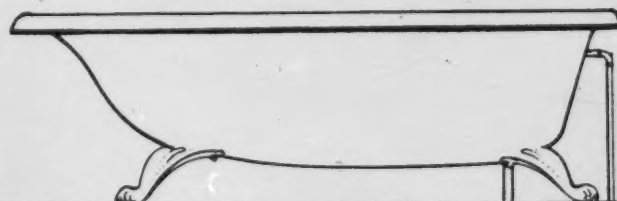
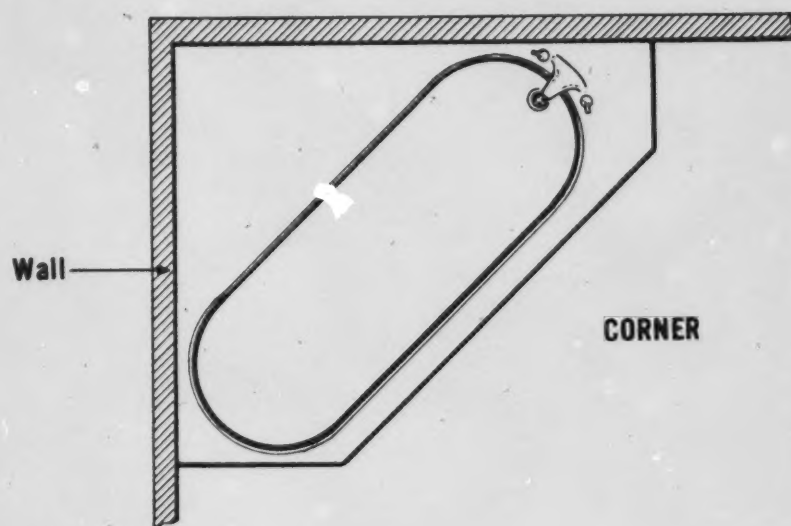
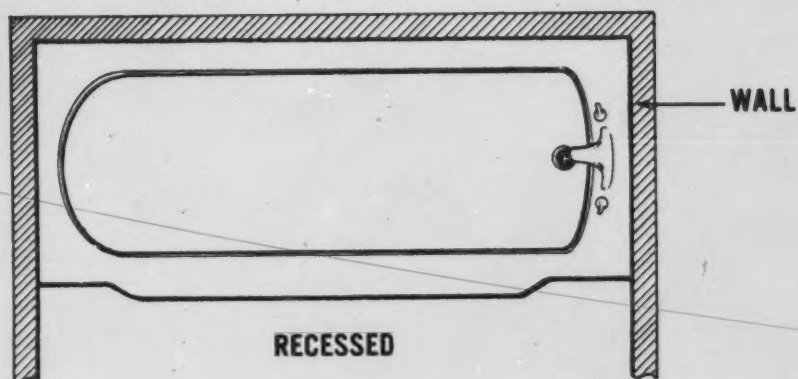


CHAIN STOPPER AND P.O. PLUG



POP-UP WASTE

TYPES OF BATHTUBS



FREESTANDING

TYPES OF BATHTUB FAUCETS

V-33



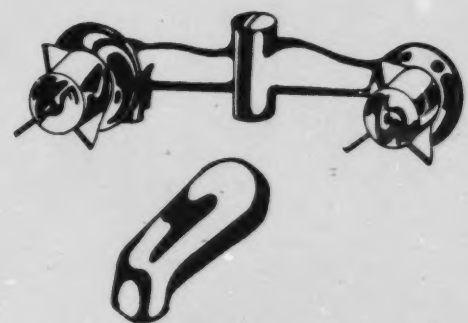
SINGLE HANDLE



SINGLE HANDLE WITH SHOWER



DOUBLE HANDLE WITH SHOWER

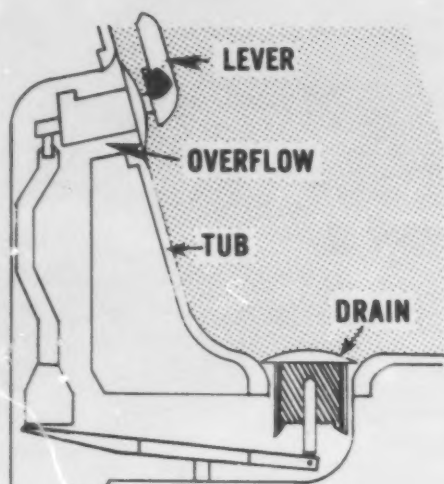


DOUBLE HANDLE

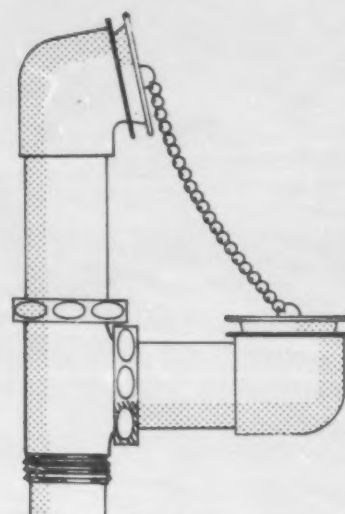
164

TM-9

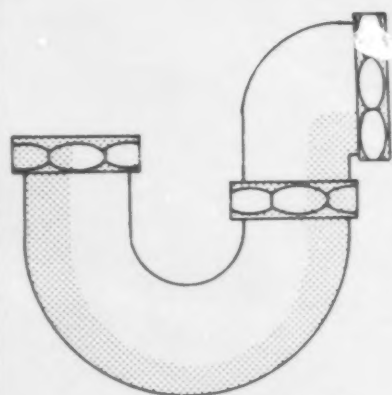
BATHTUB DRAINS AND FITTINGS



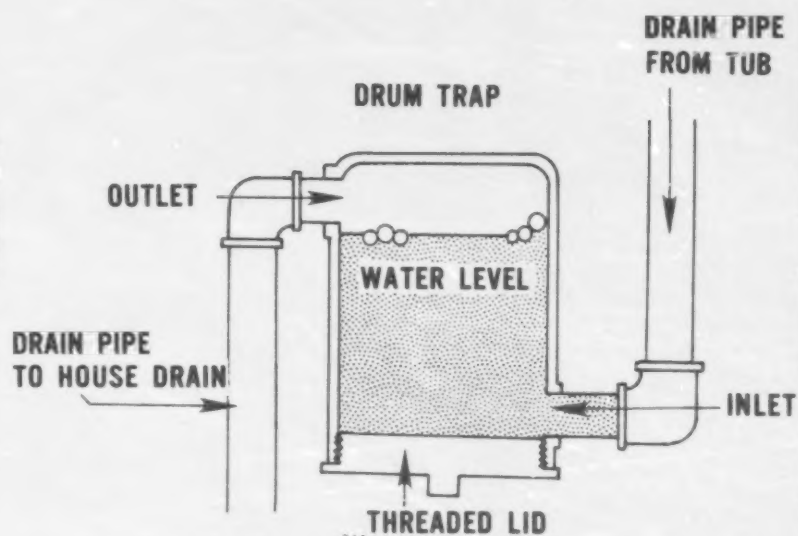
WASTE AND OVERFLOW WITH TRIP LEVER



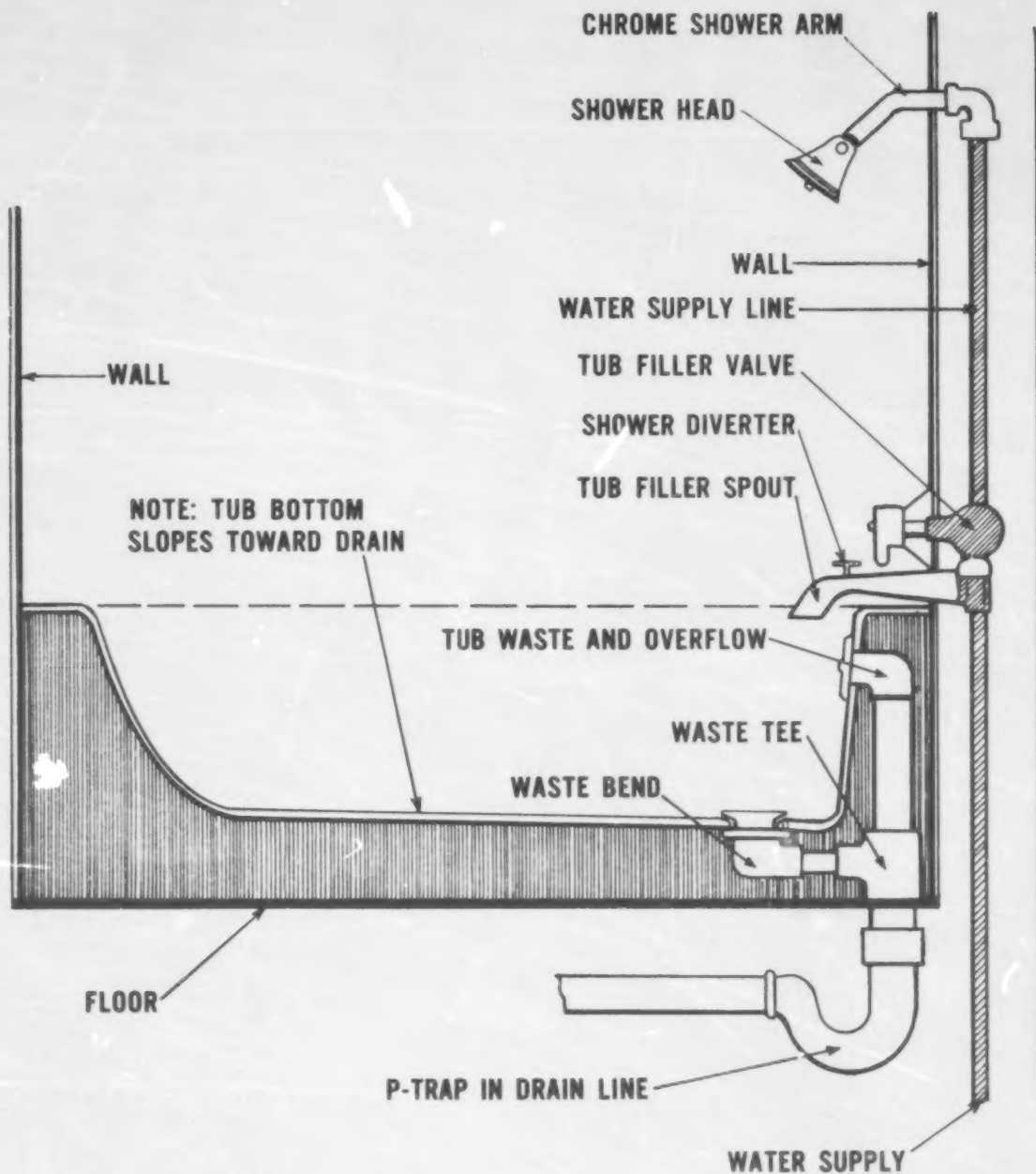
WASTE AND OVERFLOW WITH CHAIN STOPPER



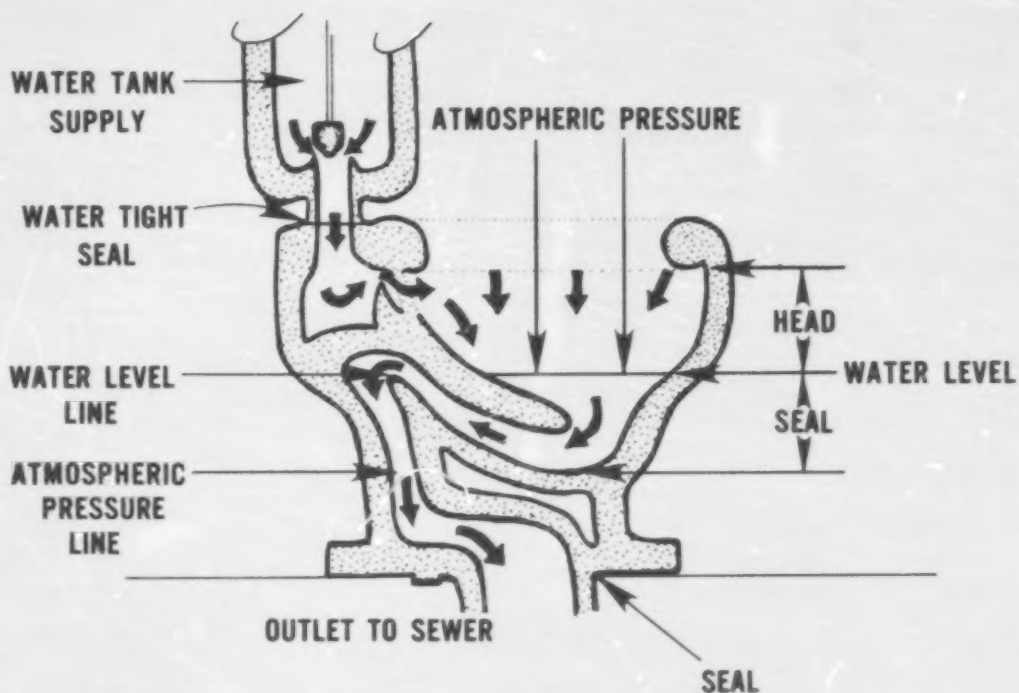
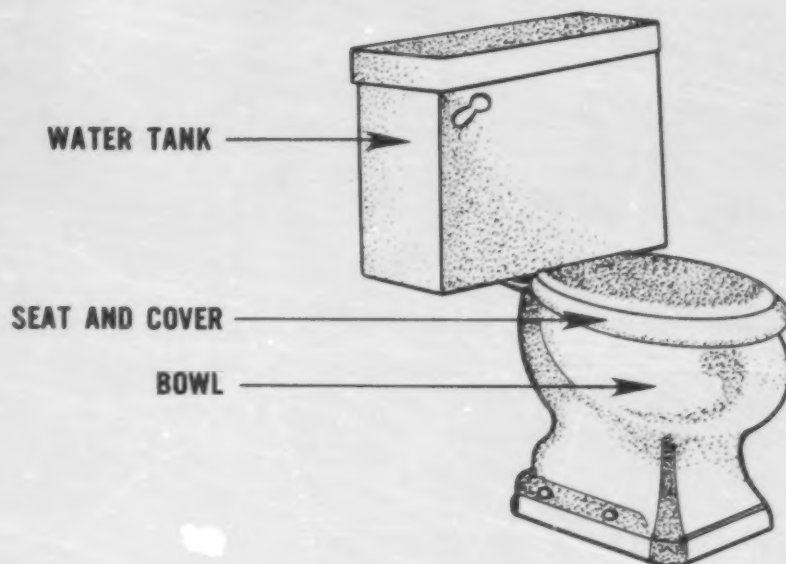
ROUGH BRASS P-TRAP



ASSEMBLY OF BATHTUB



WATER CLOSET

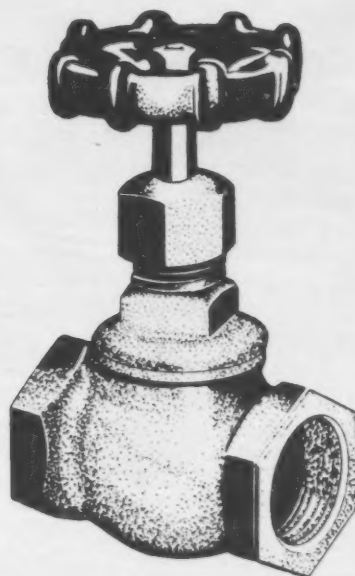


HOW A REVERSE TRAP WASH DOWN WATER CLOSET WORKS

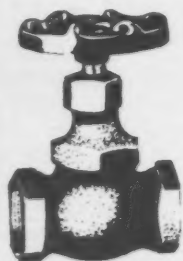
TYPES OF VALVES



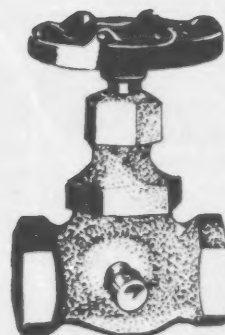
GATE



GLOBE

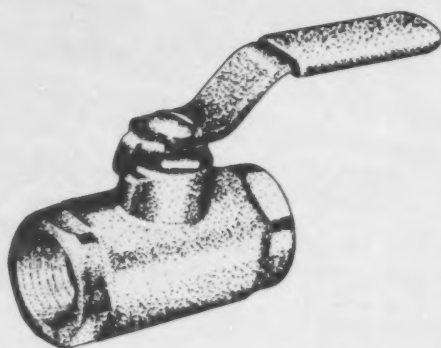


COMPRESSION

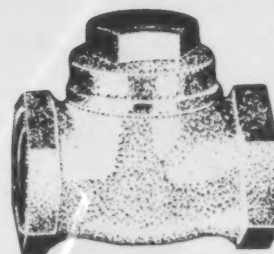


STOP & WASTE

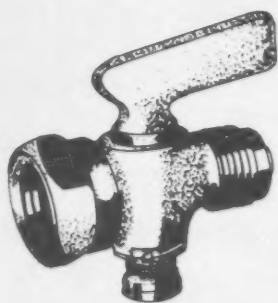
TYPES OF VALVES



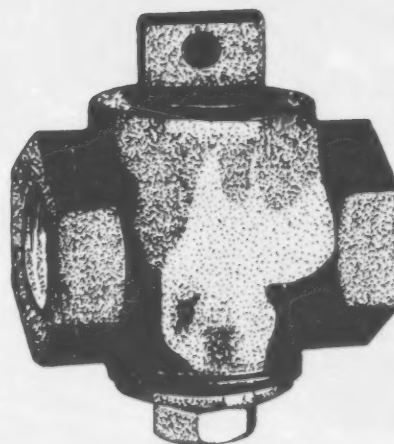
BALL



CHECK

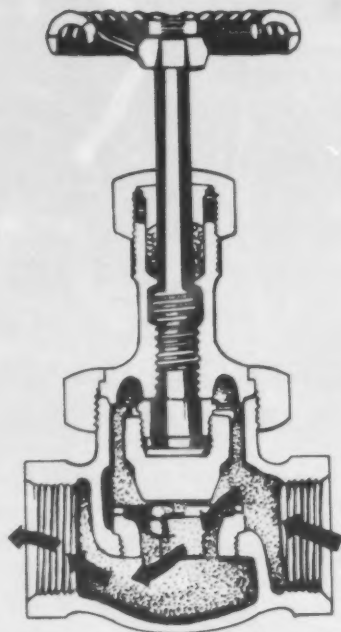


TUBE CONNECTOR

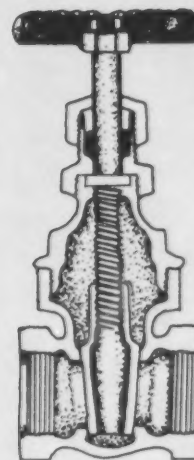


GAS STOP

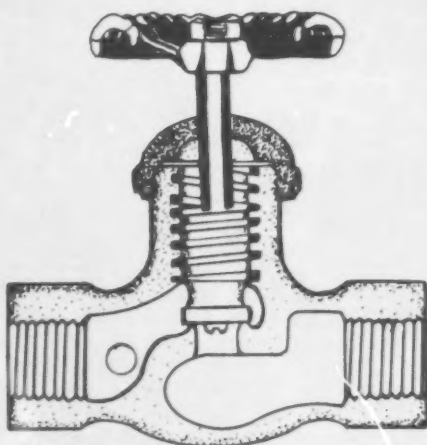
VALVE CUTAWAYS



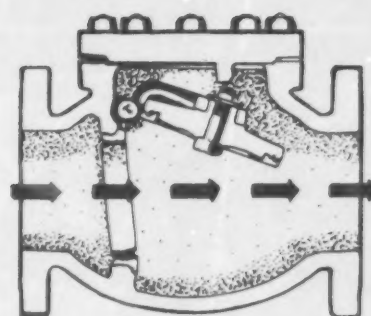
GLOBE VALVE



GATE VALVE



COMPRESSION VALVE

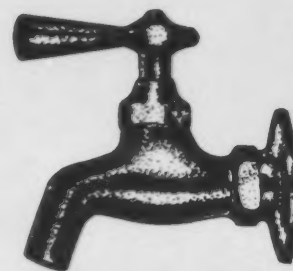


SWING-CHECK VALVE

TYPES OF BIBBS AND COCKS



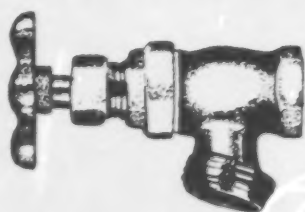
HOSE BIBB



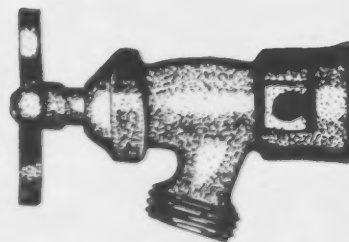
PLAIN BIBB



SILL COCK

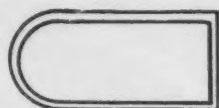


BOILER COCK



SPECIAL SILL COCK

ARCHITECTURAL PLUMBING SYMBOLS



ROLL RIM TUB



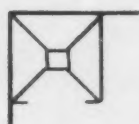
WATER METER



ANGLE TUB



HOSE BIBB OR FAUCET



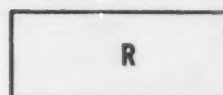
SHOWER STALL



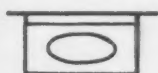
DRAIN



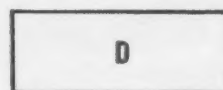
WATER CLOSET



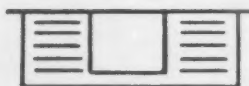
GAS RANGE



LAVATORY



DRYER

KITCHEN SINK
R & L DRAIN BOARD

WASHING MACHINE



WATER HEATER

UNIT V

FIXTURES AND VALVES

ASSIGNMENT SHEET--IDENTIFY FIXTURES AND VALVES

Directions: The instructor will prepare a display of fixtures and valves covered in this unit. A number will be assigned to each item. A list of names of the various items may be provided by the instructor. Write your answers on a sheet of paper beside the number of each item.

(NOTE: The instructor may choose to display only some of the items covered in the unit.)

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

UNIT V
FIXTURES AND VALVES

JOB SHEET--INSTALL A BATHROOM LAVATORY

I. Tools and materials

- A. Steel tape
- B. Pencil
- C. Saber saw
- D. Drill with 1/2 inch bit
- E. Lavatory and lavatory frame
- F. Frame fasteners
- G. Screwdriver

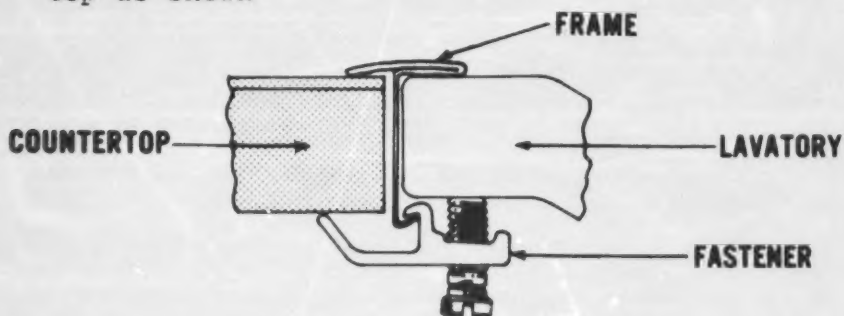
II. Procedure

- A. Determine the distance the lavatory must be away from wall
- B. Measure distance with steel tape and mark with pencil

(NOTE: Both ends of lavatory should be equal distances from the wall.)
- C. Lay the lavatory frame on countertops and line up backside with the two marks
- D. While holding frame in place, trace a line around the frame
- E. Remove the frame and check location of line for correct distance from wall
- F. Drill a hole inside the line at one of the corners so that the hole just touches the line
- G. Insert the blade of the saber saw into the hole and cut along the line
- H. Remove the cut out piece and lay the frame in the hole

(NOTE: If the frame does not fit, locate the area holding it and cut off with saber saw.)

- I. Place frame on lavatory and mount lavatory in the hole
- J. While one person holds lavatory in place, another will install frame fasteners beneath the countertop as shown



- K. Have instructor check your work
- L. Clean and store tools properly
- M. Wash your hands

UNIT V
FIXTURES AND VALVES

UNIT TEST

1. Match the terms in the right hand column to the correct definitions on the left. Place the number in the blank.

___ a. Patent overflow plug	1. valve
___ b. A device used to control the flow of gas or liquid	2. Fixture
___ c. A type of valve	3. P.O. plug
___ d. Something built into place for a specific use	4. Diverter
___ e. A faucet with a bent-over spout	5. Water closet
___ f. Glassy, slick surface	6. Vitreous
___ g. Bathroom commode	7. Bibb
___ h. The length is greater than the width	8. Faucet
___ i. A device that switches the direction of flow	9. Enamel
___ j. Bakes on finish that gives a glossy appearance	10. Elongated

2. Select the true statements about kitchen sinks. Place a "✓" in the blank.

- ___ a. The two types of kitchen sinks are the single and double compartment.
- ___ b. The three most common materials used to make sinks are vitreous china, cast iron and lead.
- ___ c. Three kinds of finishes on sinks are stainless steel, white enamel, and colored enamel.
- ___ d. Deck, wall, and dish spray are three types of faucets.
- ___ e. A sanitary tee is used to connect the sink water supply.

3. Select the true statements about bathroom lavatories by placing a "✓" in the blank.

- ☐ a. There are only round and rectangular shaped lavatories.
- ☐ b. The two types of lavatories are countertop and wall-hung.
- ☐ c. The two types of wall-hung lavatories are ledge back and flat back.
- ☐ d. The materials lavatories are made of are vitreous china, pressed steel, and lead.
- ☐ e. The two types of faucets used on lavatories are single handle and double handle.

4. List three types of hangers used to support sinks and lavatories.

- a. _____
- b. _____
- c. _____

5. Select the true statements about bathtubs. Place a "✓" in the blank.

- ☐ a. The three types of tubs are recess, corner and freestanding.
- ☐ b. The two types of materials used to make tubs are cast iron and steel.
- ☐ c. Two finishes used on tubs are white and colored enamel.
- ☐ d. A shower diverter switches the flow of water from the tub to the shower head.
- ☐ e. Both single and double handle faucets are used with bathtub.

6. Select the true statement about water closets. Place a "✓" in the blank.

- ☐ a. The two types of water closets are the washdown and syphon jet.
- ☐ b. Most water closets are made of vitreous china.

____ c. Three types of floor seals are wax, plastic, and steel.

____ d. "Close coupled" and "one piece" are two types of water closets.

7. List three types of valves.

a. _____

b. _____

8. List three types of bibbs and cocks.

a. _____

b. _____

c. _____

9. Identify the architectural plumbing symbols. Choose your answers from the list below and write it in the blank.

Roll rim tub

Water heater

Angle tub

Drain

Water closet

Hose bibb

Lavatory

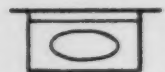
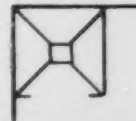
Shower stall



a. _____

b. _____

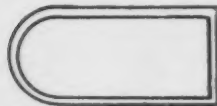
c. _____



d. _____

e. _____

f. _____



g. _____

h. _____

10. Demonstrate the ability to:

- a. Identify fixtures and valves
- b. Install a bathroom lavatory

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT V
FIXTURES AND VALVES

ANSWERS TO UNIT TEST

1. 3 a.
 1 b.
 8 c.
 2 d.
 7 e.
 6 f.
 5 g.
 10 h.
 4 i.
 9 j.
2. ✓ a.
 b. Vitreous china, pressed steel, cast iron
 ✓ c.
 ✓ d.
 e. Sanitary tee is used in waste lines
3. a. Rectangular, round, oval, 3-sided
 ✓ b.
 ✓ c.
 d. Vitreous china, pressed steel, cast iron
 ✓ e.
4. a. universal
 b. china fixture
 c. steel and cast iron

5. ✓ a.

✓ b.

✓ c.

✓ d.

✓ e.

6. ✓ a.

✓ b.

 c. wax, plastic, sponge rubber

✓ d.

7. Any three of these:

a. gate

b. globe

c. compression

d. ball

e. check

f. stop and waste

g. tube connector

h. gas stop

8. Any three of these:

a. hose bibb

b. plain bibb

c. sill cock

d. boiler cock

e. special sill cock

9.
 - a. Water closet
 - b. Angle tub
 - c. Drain
 - d. Hose bibb
 - e. Shower stall
 - f. Lavatory
 - g. Roll rim tub
 - h. Water heater
10. (a-b) Evaluated to the satisfaction of the instructor.

UNIT I
FUNDAMENTALS OF ELECTRICITY

UNIT OBJECTIVE

After completing this unit, the student will be able to identify terms common to electrical trades, and explain the basic ways of producing, distributing, and calculating cost of electricity. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to:

1. Match the term associated with electrical fundamentals to the correct definition
2. List four uses of electricity
3. Identify different types of electrical power plants
4. Identify different types of individual electrical generators
5. Identify three types of power companies
6. Identify the proper order of electricity distribution from power plant to user
7. Write the name of the local power company
8. Distinguish the difference between 110 volt and 220 volt services
9. List two types of electrical rates
10. Identify two types of electric meters
11. Determine kilowatt-hours of electricity used and its cost by reading a pointer-dial meter
12. Figure kilowatt-hours of electricity for electrical appliances
13. Select the correct formula for figuring wattage of 110 and 220 volt motors
14. Demonstrate the ability to:
 - a. Figure electrical power used

- b. Figure cost of electrical power used
- c. Read pointer-dial electric meters and figure electric bills

UNIT I
FUNDAMENTALS OF ELECTRICITY

SUGGESTED ACTIVITIES

- I. Instructor
 - A. Discuss unit objective
 - B. Provide student with information sheet
 - C. Prepare transparencies and lesson plan
 - D. Discuss information and assignment sheets
 - E. Have students complete assignment sheets
 - F. Take students to visit local power plant
 - G. Have guest speaker associated with electrical trades
 - H. Give test
 - I. Review problem areas pointed out by the test
- II. Student
 - A. Discuss any question on unit objective
 - B. Read and discuss information and assignment sheets
 - C. Complete assignment sheets
 - D. Discuss field trips taken
 - E. Take test
 - F. Discuss test questions missed

INSTRUCTIONAL MATERIALS

- I. Included in this unit
 - A. Objectives
 - B. Information sheets
 - C. Transparency masters

1. TM-1--Power Distribution
2. TM-2--Pointer-Dial Electric Meter
3. TM-3--Cyclometer Electric Meter

D. Assignment sheets

1. Assignment Sheet #1--Figure Electrical Power Used
2. Assignment Sheet #2--Figure Cost of Electrical Power Used
3. Assignment Sheet #3--Read Pointer Dial Electric Meters and Figure Bills

E. Test

F. Answers to test

II. References

- A. Coordinated Vocational Education and Training - General Construction Trades. Stillwater, Okla.: State Department of Vocational and Technical Education.
- B. Construction Industry Series, Student Manual Preparation and Development. Austin, Texas: Texas Education Agency.
- C. Construction Industry Series, Instructor's Guide - Preparation Level. Austin, Texas: Texas Education Agency.
- D. Mix, Floyd M. House Wiring Simplified. South Holland, Illinois: The Goodheart-Wilcox Co.
- E. Understanding Electricity and Electrical Terms. Athens, Georgia: American Association for Vocational Instructional Materials Engineering Center.

UNIT I
FUNDAMENTALS OF ELECTRICITY

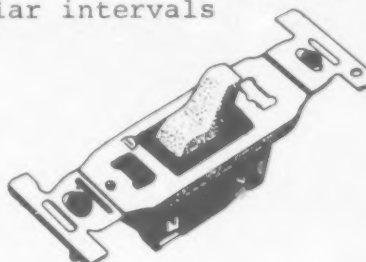
INFORMATION SHEET

I. Terms and definitions

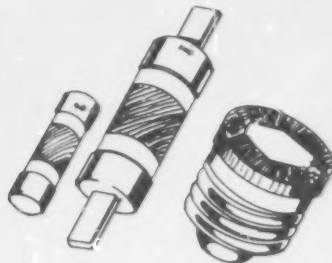
- A. Electricity--A form of energy which can be converted to practical use
- B. Volt (V)--A unit of measure of electrical pressure
- C. Ampere (AMP)--A unit of measure of electrical current flowing through a wire
- D. Watt (W)--A unit of measure used in determining electrical power

(NOTE: Determined by multiplying volts times amperes)
- E. Watt hour--One watt used for one hour
- F. Kilowatt (KW)--1000 watts
- G. Kilowatt hour (KWH)--1000 watts used for one hour

(NOTE: Unit by which electricity is sold)
- H. Circuit--A complete path through which electricity flows, such as from the power source through a lamp and back to the power source
- I. Horsepower (HP)--A unit of mechanical power which is equal to 746 watts of electrical power
- J. Resistance (OHM)--Electrical friction
- K. Direct current (DC)--Electrical current flowing in one direction at a continuous rate
- L. Alternating current (AC)--Electrical current that reverses direction at regular intervals
- M. Switch--A device used to open or close a circuit



- N. Fuse--A safety device which burns out when current becomes too great



- O. Circuit breaker--A safety device which opens the circuit by tripping a switch rather than burning out the wiring or appliance



(NOTE: A circuit breaker can be reset after cooling.)

- P. Conductors--Materials through which electrical current flows



- Q. Insulation--A protective covering over wires to prevent completing a circuit except where desired
- R. Hot wire--The current-carrying conductor with electrical pressure on it
- S. Neutral wire--The current-carrying conductor with no electrical pressure on it

(NOTE: Usually white)

- T. Ground--A connection to the earth which serves as a return circuit

(NOTE: Ground wires also prevent electrical shock.)

- U. Electric meter--Device which measures amount of electricity used in kilowatt hours
- V. Short circuit--An improper connection between hot and neutral wires or between two hot wires

II. Uses of electricity

- A. Lighting
- B. Heating
- C. Cooling
- D. Power
- E. Communications
- F. Special

III. Types of electrical power plants

- A. Hydro-electric plants
- B. Gas-fired electric plants
- C. Coal-fired electric plants
- D. Atomic generating plants

IV. Types of individually owned electrical generators

- A. Wind powered
- B. Gasoline powered
- C. Solar powered

V. Types of power companies

- A. Publicly owned
- B. Privately owned
- C. Cooperatives

VI. Types of power lines (Transparency #1)

- A. Transmission lines--Electrical lines that extend from generating plant to sub-station or distribution center
- B. Distribution lines--Electrical lines that begin at the sub-station or distribution center and extend to the user

(NOTE: Usually running under 20 miles)

- C. Service lines--Electrical lines that run from distribution lines to meter pole

- D. Feeder lines--Electrical lines that run from the meter to point of use

VII. Local companies (List)

- A.
- B.
- C.

VIII. Different electrical services

- A. 110 volt--Two lines running to house
- B. 220 volt--Three lines running to house

IX. Electricity rates

- A. Residential
- B. Commercial
- C. Special
- D. Fuel adjustment charge

X. Types of electric meters

- A. Pointer and dial (Transparency #2)
- B. Cyclometer (Transparency #3)

XI. Figuring residential rates

- A. First 25 KWHs at 7¢ per KWH
- B. Next 25 KWHs at 5¢ per KWH
- C. Next 50 KWHs at 3¢ per KWH
- D. Over 100 KWHs at 1¢ per KWH
- E. Plus fuel adjustment charge
- F. Total of A through E

Example of figuring rates:

1. First 25 KWHs at 7¢ = \$1.75
2. Next 25 KWHs at 5¢ = \$1.25

3. Next 50 KWHs at 3¢ = \$1.50
4. 250 KWHs (over 100 KWH) at 2¢ = \$2.50
5. Subtotal = \$7.00
6. 10% fuel adjustment charge = \$.70
7. Total = \$7.70

XII. Figuring kilowatt hours of electricity

- A. Volts x amps = watts
- B. Watts x hours of use = watt hours
- C. $\frac{\text{Watts x hours of use}}{1000} = \text{kilowatt hours}$

XIII. Figuring electricity used by 110- and 220-volt motors

A. 110-volt motors

1. For smaller than 1/2 horsepower, multiply horsepower rating by 1200 = watts.
2. For 1/2 horsepower or larger, multiply horsepower rating x 1000 = watts.

Example of figuring electricity used:

- a. 1/3 HP motor x 1200 = 400 watts
- b. 400 watts x 3 hours use = 1200 watt hours
- c. $\frac{1200 \text{ WH}}{1000} = 1.2 \text{ KWH}$

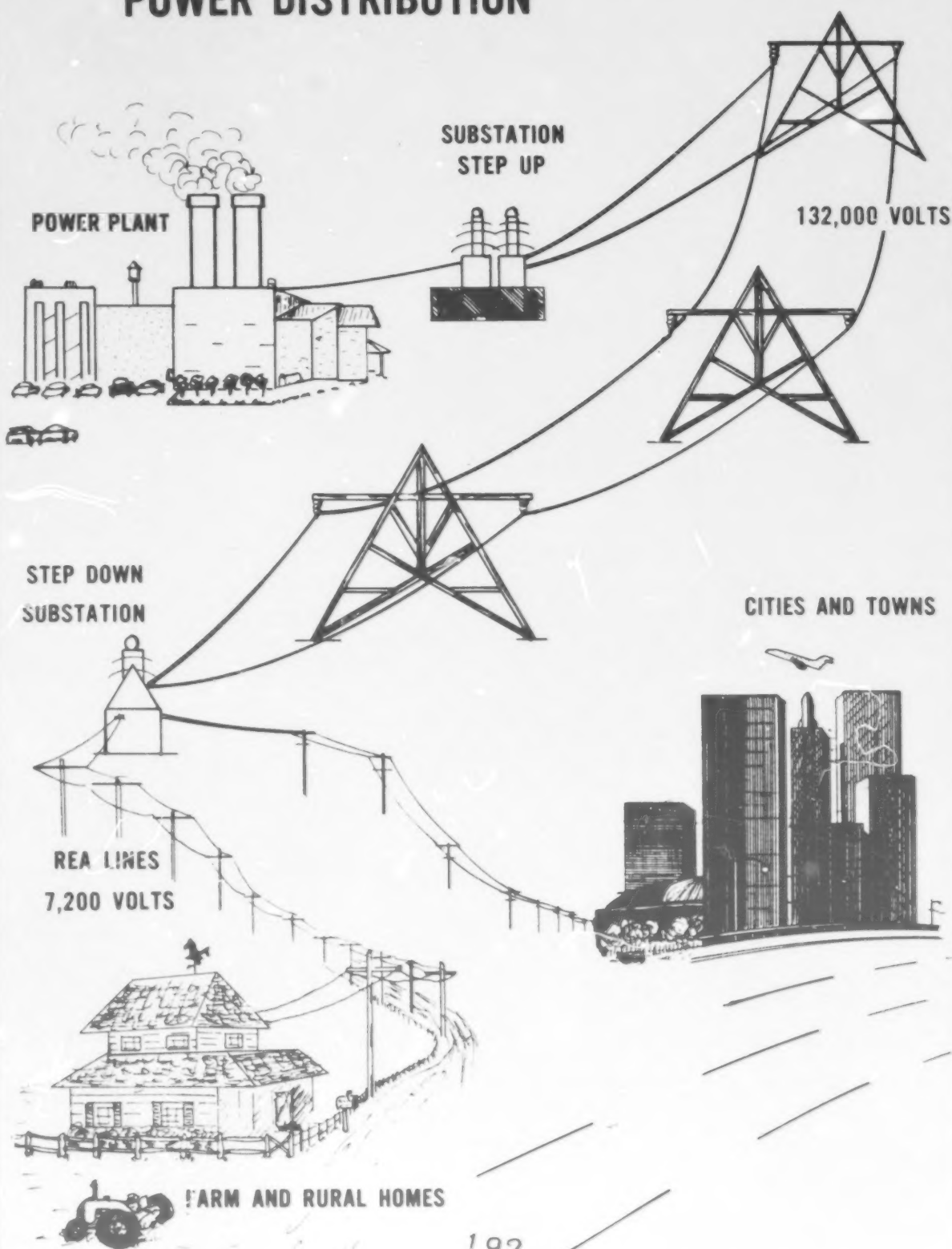
B. 220-volt motors

1. For smaller than 1/2 horsepower, multiply horsepower rating x 600 = watts
2. For 1/2 horsepower or larger, multiply horsepower rating x 600 = watts

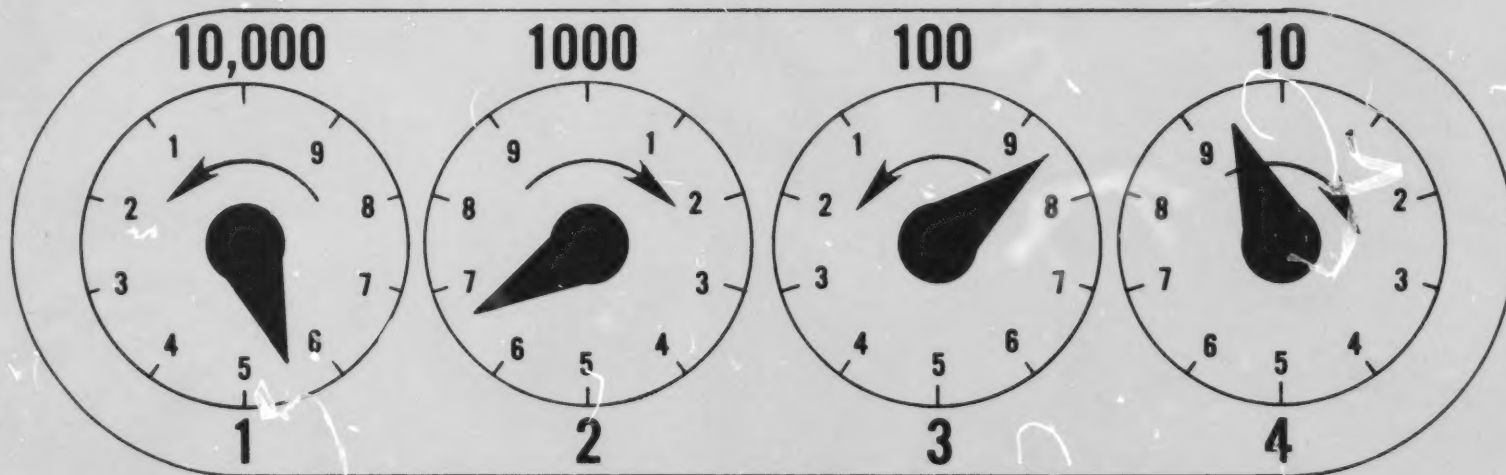
Example of figuring electricity used:

- a. 2/3 HP motor x 600 = 400 watts
- b. 400 watts x 5 hours used = 2000 watt-hrs.
- c. $\frac{2000 \text{ WH}}{1000} = 2 \text{ KWH}$

POWER DISTRIBUTION



POINTER-DIAL ELECTRIC METER



Cyclometer Electric Meter

GENERAL  ELECTRIC

0 1 2 3 4

KILOWATT HOURS

Rr 13⁸/₉

4. An electric meter read 1130 on July 30 and on August 30 it read the following:



Reading _____

Previous Reading - 1130 _____

KWH used _____

5. How many kilowatt hours will a 1 1/2 HP - 110 volt motor use in 5 hours?

_____ HP of motor
 x 1000
 = _____ watts
 x _____ hours of operation
 = _____ watt hours
 ÷ 1000
 = _____ KWH used

UNIT I
FUNDAMENTALS OF ELECTRICITY

ASSIGNMENT SHEET #2--FIGURE COST OF ELECTRICAL POWER USED

Directions: Work all of the problems listed below. Use the average cost of 3¢ per KWH of electricity. Show your work in space provided.

1. Figure the cost of burning a 200-watt bulb for 15 hours.

_____ watts of bulb
 x _____ hours bulb used
 = _____ watt hours
 ÷ 1000
 _____ KWH used
 x _____ price per KWH
 _____ cost of burning bulb 15 hours

2. How much would it cost to run a 110V, 1/2-HP motor for 10 hours?

_____ HP of motor
 x 1000
 = _____ watts
 x _____ hours of operation
 = _____ watt hours
 ÷ 1000
 = _____ KWH used
 x _____ price per KWH
 = _____ cost of operating motor for 10 hours

3. How much money would you owe the power company if you operated a 220V, 2-HP motor for 5 hours?

_____ HP of motor

$$\times \underline{600}$$

$$= \underline{\hspace{2cm}} \text{ watts}$$

$$\times \underline{\hspace{2cm}} \text{ hours of operation}$$

$$= \underline{\hspace{2cm}} \text{ watt hours}$$

$$\div \underline{1000}$$

$$= \underline{\hspace{2cm}} \text{ KWH used}$$

$$\times \underline{\hspace{2cm}} \text{ price per KWH}$$

$$= \underline{\hspace{2cm}} \text{ cost of operating motor for 5 hours}$$

4. A freezer uses 500 watts of electricity. What would it cost to run it for 30 days if it runs an average of 4 hours per day?

$$\underline{\hspace{2cm}} \text{ number of days operated}$$

$$\times \underline{\hspace{2cm}} \text{ hours operated per day}$$

$$= \underline{\hspace{2cm}} \text{ total hours of operation}$$

$$\times \underline{\hspace{2cm}} \text{ watts used per hour}$$

$$= \underline{\hspace{2cm}} \text{ watt hours}$$

$$\div \underline{1000}$$

$$= \underline{\hspace{2cm}} \text{ KWH used}$$

$$\times \underline{\hspace{2cm}} \text{ price per KWH}$$

$$= \underline{\hspace{2cm}} \text{ cost of operating for 30 days}$$

5. An electric heater uses 1350 watts. What would be the cost of operating the heater 6 hours per day for 30 days?

$$\underline{\hspace{2cm}} \text{ number of days operated}$$

$$\times \underline{\hspace{2cm}} \text{ hours operated per day}$$

$$= \underline{\hspace{2cm}} \text{ total hours of operation}$$

$$\times \underline{\hspace{2cm}} \text{ watts used per hour}$$

$$= \underline{\hspace{2cm}} \text{ watt-hours}$$

200

$$\div \underline{1000}$$

= _____ KWH used

x _____ price per KWH

= _____ cost of operating for 30 days

UNIT I
FUNDAMENTALS OF ELECTRICITY

ASSIGNMENT SHEET #3--READ POINTER DIAL ELECTRIC METERS
AND FIGURE ELECTRIC BILLS

Directions: Work all of the following problems and show your work. Read the meters, subtract the previous readings and figure the electric bill from the information provided.

1.



average cost of electricity 3¢ per KWH

meter reading _____

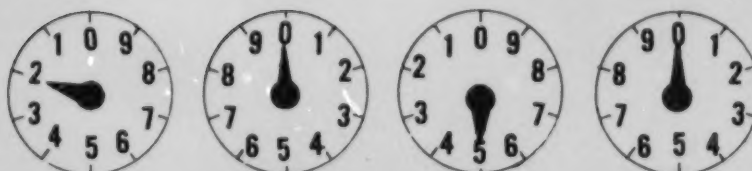
previous reading -7120

= _____ KWH used

x _____ price per KWH

= _____ amount of bill

2.



First 20 KWH at 6¢ per KWH

Next 20 KWH at 4¢ per KWH

Next 60 KWH at 2¢ per KWH

Over 100 KWH at 1¢ per KWH

Meter reading _____

Previous reading - 1040

_____ KWH used

- 100 KWH

_____ KWH used over 100 KWH

$$20 \text{ KWH} \times 6\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$20 \text{ KWH} \times 4\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$60 \text{ KWH} \times 2\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$\underline{\hspace{1cm}} \text{ KWH over } 100 \times 1\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$\text{Amount of bill} = \underline{\hspace{2cm}}$$

3.



Meter reading

Previous reading -1575

 KWH used

$$20 \text{ KWH} \times 5\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$20 \text{ KWH} \times 4\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$60 \text{ KWH} \times 3\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$100 \text{ KWH} \times 2\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$\underline{\hspace{1cm}} \text{ KWH over } 200 \times 1\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$\text{Amount of bill} = \underline{\hspace{2cm}}$$

4.



Meter reading

Previous reading -1230

 KWH used

$$20 \text{ KWH} \times 4\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$20 \text{ KWH} \times 3\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$60 \text{ KWH} \times 2\text{¢ per KWH} = \underline{\hspace{2cm}}$$

$$\underline{\hspace{1cm}} \text{ KWH over } 100 \times 1\text{¢ per KWH} = \underline{\hspace{2cm}}$$

total _____
10% fuel adjustment + _____
amount of bill = _____

UNIT I

FUNDAMENTALS OF ELECTRICITY

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. 1700 watt hours
2. 13.5 KWH
3. 743 KWH
4. meter reading 2150
KWH used 1020
5. 1 1/2 HP of motor
1500 watts
7500 watt hours
7.5 KWH used

Assignment Sheet #2

1. 200 watts of bulb
15 hrs. bulb used
3000 watt hours
3 KWH
3¢ per KWH
9¢ cost of burning bulb 15 hours
2. 1/2 HP of motor
500 watts
10 hours of operation
5000 watt hours
5 KWH used
3¢ per KWH
15¢ cost of operating motor for 10 hours
3. 2 HP of motor
1200 watts
5 hours of operation
6000 watt hours
6 KWH used
3¢ per KWH
18¢ cost of operating motor for 5 hours
4. 30--number of days operated
4 hours operated per day
120 total hours of operation
500 watts used per hour
60000 watt hours
60 KWH used

3 per KWH
\$1.80 cost of operating for 30 days

5. 30--number of days operated
6 hours operated per day
180 total hours of operation
1350 watts used per hour
243000 watt hours
243 KWH used
3¢ price per KWH
\$7.29 cost of operation for 30 days

Assignment Sheet #3

1. meter reading 8331
KWH used 1211
price per KWH 3¢
amount of bill \$36.33
2. meter reading 2050
KWH used 1010
KWH used over 100--910
20 KWH x 6¢ = \$1.20
20 KWH x 4¢ = 80¢
60 KWH x 2¢ = \$1.20
910 KWH x 1¢ = \$9.10
amount of bill = \$12.30
3. meter reading 1929
KWH used 354
20 KWH x 5¢ = \$1.00
20 KWH x 4¢ = 80¢
60 KWH x 3¢ = \$1.80
100 KWH x 2¢ = \$2.00
154 KWH x 1¢ = \$1.54
amount of bill = \$7.14
4. meter reading 1842
KWH used 612
20 KWH x 4¢ = 80¢
20 KWH x 3¢ = 60¢
60 KWH x 2¢ = \$1.20
512 KWH x 1¢ = \$5.12
total = \$7.72
10% fuel adjustment = 77¢
amount of bill = \$8.49

UNIT I
FUNDAMENTALS OF ELECTRICITY

UNIT TEST

1. Match the terms in the right hand column to the correct definition on the left by placing the number in the blank.

- | | |
|---|------------------|
| ___ a. A source of energy that can be converted to light, heat or power | 1. kilowatt |
| ___ b. A unit of measure of electrical power | 2. switch |
| ___ c. 1,000 watts | 3. kilowatt-hour |
| ___ d. A unit of measure of electrical pressure | 4. horsepower |
| ___ e. A device used to open and close a circuit | 5. electricity |
| ___ f. Path through which electricity flows | 6. watt |
| ___ g. 1,000 watts for 1 hour | 7. conductors |
| ___ h. A unit of mechanical power equal to 746 watts | 8. volt |
| ___ i. Material through which electrical current flows | 9. hot wire |
| ___ j. The current-carrying conductor with electrical pressure on it | 10. ground |
| ___ k. Usually the white wire | 11. circuit |
| ___ l. Reduces the danger of electrical shock | 12. neutral wire |

2. List four uses of electricity

- a.
- b.
- c.
- d.

3. Place a "✓" in the blank beside the terms below which identify a type of electrical power plant.

- ___ a. Hydro-electric
- ___ b. Gas-fired
- ___ c. Wood-fired
- ___ d. Atomic

4. Place a "✓" in the blank beside the terms below which identify a type of individual electrical generator.

- ___ a. Wind-powered
- ___ b. Horse-powered
- ___ c. Gasoline-powered
- ___ d. Solar-powered

5. Place a "✓" in the blank beside the terms below which identify a type of power company.

- ___ a. Public
- ___ b. Combined
- ___ c. Cooperative
- ___ d. Private

6. Arrange the types of power lines listed below in the proper order from power plant to user by placing the number 1, 2, 3, or 4 in the blanks beside the term

- ___ a. Distribution line
- ___ b. Transmission line
- ___ c. Feeder line
- ___ d. Service line

7. The name of your local power company is (are) _____.

8. Fill in the blanks with either 110 or 220 to make the following statement true:

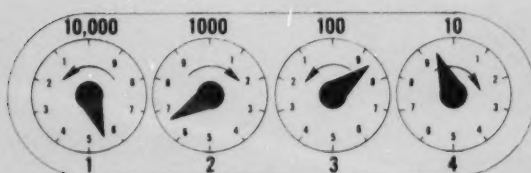
A house with three electric lines leading to it has (a) _____ volt service and if there are only two lines leading to it, it has a (b) _____ volt service.

9. List two types of electrical rates.

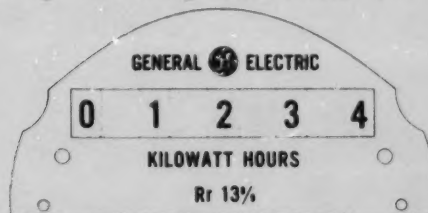
a. _____

b. _____

10. Identify the two meters below by writing the name of each in the blank below.



a. _____



b. _____

11. Read the meter below.



The meter reading is _____

Using the meter reading above and the information below figure the KWH of electricity used and the amount of the bill.

Previous reading 8760
 First 100 KWH at 6¢ per KWH
 Next 100 KWH at 4¢ per KWH
 Next 300 KWH at 2¢ per KWH
 Above 500 KWH at 1¢ per KWH

KWH used _____ Amount of bill _____

12. Figure the kilowatt-hours of electricity for operating electrical appliances by solving the problem below.

a 110-volt, 10-amp hair dryer was operated for one hour. How many kilowatt hours of electricity were used?

$$\begin{array}{rcl} \underline{\hspace{2cm}} & \text{volts} \times & \underline{\hspace{2cm}} \text{ amps} = \underline{\hspace{2cm}} \text{ watts} \\ \underline{\hspace{2cm}} & \text{watts} \times & \underline{\hspace{2cm}} \text{ hours of use} = \underline{\hspace{2cm}} \text{ KWH} \\ & & \underline{\hspace{2cm}} \\ & & 1000 \end{array}$$

13. Select the correct formula for figuring wattage of 110 and 220-volt motors by placing a "/" in the blank beside each statement that is true.

- ☐ a. For a 110-volt, 1/3 HP motor, multiply HP rating by 1200 to determine watts.
- ☐ b. For a 110-volt, 1/2 HP motor, multiply HP rating by 1000 to determine watts.
- ☐ c. For a 220-volt, 1/3 HP motor, multiply HP rating by 800 to determine watts.
- ☐ d. For a 220-volt, 1/2 HP motor, multiply HP rating by 600 to determine watts.

14. Demonstrate the ability to:

- a. Select the correct formula for figuring wattage of 110 and 220-volt motors.
- b. Figure electrical power used.
- c. Figure cost of electrical power used.
- d. Read pointer dial electric meters and figure electric bills.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT I
FUNDAMENTALS OF ELECTRICITY

ANSWERS TO UNIT TEST

1.
 - a. 5
 - b. 6
 - c. 1
 - d. 8
 - e. 2
 - f. 11
 - g. 3
 - h. 4
 - i. 7
 - j. 9
 - k. 12
 - l. 10
2. Any 5 of these 6
 - a. Lights
 - b. Heating
 - c. Cooling
 - d. Power
 - e. Communications
 - f. Special
3.

<u> ✓ </u>	a.
<u> ✓ </u>	b.
<u> </u>	c.
<u> ✓ </u>	d.

4. ✓ a.
 b.
✓ c.
✓ d.
5. ✓ a.
 b.
✓ c.
✓ d.
6. 2 a.
1 b.
4 c.
3 d.
7. Determined by instructor
8. a. 220
b. 110
9. Any 2 of these 4
 - a. Residential
 - b. Commercial
 - c. Special
 - d. Fuel adjustment charge
10. a. Pointer and dial
b. Cyclometer
11. Meter reading is 9951
KWH used 1191
Amount of bill \$22.91
12. 1.1 kilowatt hours

212

13. ✓ a.

✓ b.

 c.

✓ d.

14. a. Evaluated to the satisfaction of the instructor.

b. Evaluated to the satisfaction of the instructor.

c. Evaluated to the satisfaction of the instructor.

d. Evaluated to the satisfaction of the instructor.

UNIT II
ELECTRICAL SAFETY

UNIT OBJECTIVE

After completing this unit, the student will use safe practices while working with electricity and recognize unsafe situations in the home and shop. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit the student will be able to:

1. Match the terms and definitions associated with electrical safety.
2. List four results of electrical accidents.
3. Identify the effects of electrical accidents.
4. Point out the common causes of electrical accidents.
5. Point out the proper procedures for helping an electrical shock victim.
6. List three classes of fires.
7. Determine for which class of fire each type of extinguisher is used.
8. Select correct work area safety factors.
9. Identify correct tool and equipment safety factors.
10. Select correct electrical installation factors.
11. Select special precautions in electrical safety.
12. Demonstrate the ability to:
 - a. Identify unsafe electrical conditions in the shop and classroom.
 - b. Identify unsafe electrical conditions in the home and garage.

- c. Identify five types of fire extinguishers.
- d. Prepare an electrical safety poster.

UNIT II
ELECTRICAL SAFETY

SUGGESTED ACTIVITIES

- I. Instructor:
 - A. Discuss unit objectives
 - B. Provide students with information and assignment sheets
 - C. Prepare transparencies and lesson plans
 - D. Discuss information and assignment sheets
 - E. Order and show films and posters on electrical safety
 - F. Give test
 - G. Review problem areas identified by test
- II. Student:
 - A. Discuss questions of unit objective
 - B. Read and discuss information and assignment sheets
 - C. Complete assignment sheets
 - D. Discuss any information covered in films
 - E. Take unit test
 - F. Discuss test questions missed

INSTRUCTIONAL MATERIALS

- I. Included in this unit:
 - A. Objective sheet
 - B. Information sheet
 - C. Transparency masters
 - 1. II-TM-1--Effects of Electrical Accidents
 - 2. II-TM-2--Results of Electrical Accidents

3. II-TM-3--Human Failure
4. II-TM-4--Failure
5. II-TM-5--Carelessness
6. II-TM-6--Misuse
7. II-TM-7--Electrical Shock Victims
8. II-TM-8--Types of Fire Extinguishers
9. II-TM-9--Work Area Safety

D. Assignment sheets

1. Assignment Sheet #1--Safety Survey
2. Assignment Sheet #2--Safety Inspection
3. Assignment Sheet #3--Identify Five Types of Fire Extinguishers
4. Assignment Sheet #4--Prepare Electrical Safety Poster

E. Unit test

F. Answers to the unit test

II. References:

- A. Mix, Floyd. House Wiring Simplified. South Holland, Illinois: Goodheart-Wilcox Company, Inc. 1973.
- B. General Construction Trades. State Department of Vocational and Technical Education, Stillwater, Oklahoma, 1971.
- C. Electricity. Construction Industry Series Student Manual. Austin, Texas: Texas Education Agency, 1975.
- D. National Safety Council Catalog and Poster Directory. National Safety Council, 425 N. Michigan Ave., Chicago, Illinois, 60611. 1975-76.

UNIT II
ELECTRICAL SAFETY
INFORMATION SHEET

I. Terms and definitions

- A. Accident--Any sudden, unplanned event which causes injury or property damage
- B. Safety--State or condition of being safe, free from danger, risk or injury
- C. Electrical shock--The result of electrical discharge through a person's body
- D. Defective--Not in proper working order
- E. Approved--Minimum standards established by authorities have been met



- F. Ground--A connection to the earth which serves as a return circuit and reduces danger
- G. Short circuit--Improper connection between hot wires or between hot and neutral wires
- H. Overload--A circuit or device forced to carry more electrical current than design allows
- I. Live wire--Current-carrying wire
(NOTE: Current kills!)
- J. Dead circuit--A disconnected circuit, usually caused by removing fuse, tripping breaker or disconnecting service
- K. Modification--A slight change in form or operation
- L. Qualified person--A person who is thoroughly familiar with the work area involved

II. Effects of electrical accidents (Transparency #1)

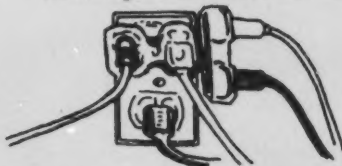
- A. Shock
- B. Burns
- C. Falls and spills
- D. Cuts and abrasions

III. Results of electrical accidents (Transparency #2)

- A. Death--One amp for one second of contact can cause death
- B. Crippling--Severe burns can cause loss of limb, sight, or mobility
- C. Loss of time--Electrical associated accidents account for 4% of job time lost in U.S.
- D. Loss of material--Fire caused by electricity results in about \$211,000,000 of material loss each year.
- E. Loss of job--Most employers will not keep a dangerous worker on the job.

IV. Common causes of electrical accidents

- A. Human failure--Not using safe work practices (Transparency #3)
- B. Failure--Not making necessary repairs to faulty equipment (Transparency #4)
- C. Carelessness--Not observing safety rules (Transparency #5)
- D. Modification--Making unauthorized changes in equipment



- E. Misuse--Using something in an improper manner (Transparency #6)
- F. Defective equipment
 - 1. Ground wire
 - a. missing

- b. broken
- c. improper connection
- d. not connected

2. Insulation

- a. wet
- b. worn
- c. cut
- d. oily

G. Defective tools

- 1. Broken guard
- 2. Damaged power cord
- 3. Improper or no switch
- 4. Broken handle
- 5. Loose fasteners

H. Ignorance--Not knowing proper procedure

V. Electrical shock victims (Transparency #7)

- A. If possible, turn off electricity causing shock.
- B. Remove hot wire from victim using dry wood, plastic, glass or fiberglass article.
- C. Remove victim from source of electricity after insulating yourself with thick layers of dry paper or cloth.
- D. Administer mouth-to-mouth resuscitation.
- E. Call an ambulance or doctor.
- F. Notify power company.
- G. Watch for possible electrical fire.

VI. Classes of fires

- A. Class A--Ordinary combustible materials such as rags, paper, and wood

- B. Class B--Flammable liquids such as gasoline, oil and paint thinner
- C. Class C--Electrical fires in wires or electric motors

VII. Types of fire extinguishers (Transparency #8)

- A. Soda-acid--Use on class A fires only
- B. Pressurized water--Use on class A fires only
- C. Foam--Use on class A and B fires only
- D. Carbon dioxide--Use on class A, B, or C fires
- E. Dry chemical--Use on class A, B, or C fires

VIII. Work area safety factors (Transparency #9)

- A. Work area must be free of loose tools.
- B. Work area must be free of loose materials and debris.
- C. Floors must be free of water, oil, grease, or other liquids.
- D. Work only on dead circuits.
- E. Keep good housekeeping and work habits.

IX. Tool and equipment safety factors

- A. Proper operation of equipment
- B. Clean tools
- C. Insulated handles to prevent shock
- D. Cutting tools kept sharp
- E. Use proper tool for the job

X. Electrical installation safety factors

- A. Check circuit with test light before starting work.
- B. Equipment and tools must be dry.
- C. Work on only one side of a circuit at a time.

D. Insulate your body when working with live wires by wearing:

1. Lineman's gloves
2. Rubber-soled shoes
3. Approved electrical worker's hard hat

E. Work on dead circuits whenever possible.

F. Ladders

1. Use ladders that are unpainted and in good repair.
2. Do not use metal ladders for electrical work.
3. Ladder base should be $1/4$ the ladder's length away from wall.
4. All feet of folding ladders must be level on the ground or floor.

G. Cut away from the body when stripping wire with a knife.

XI. Special precautions in electrical safety

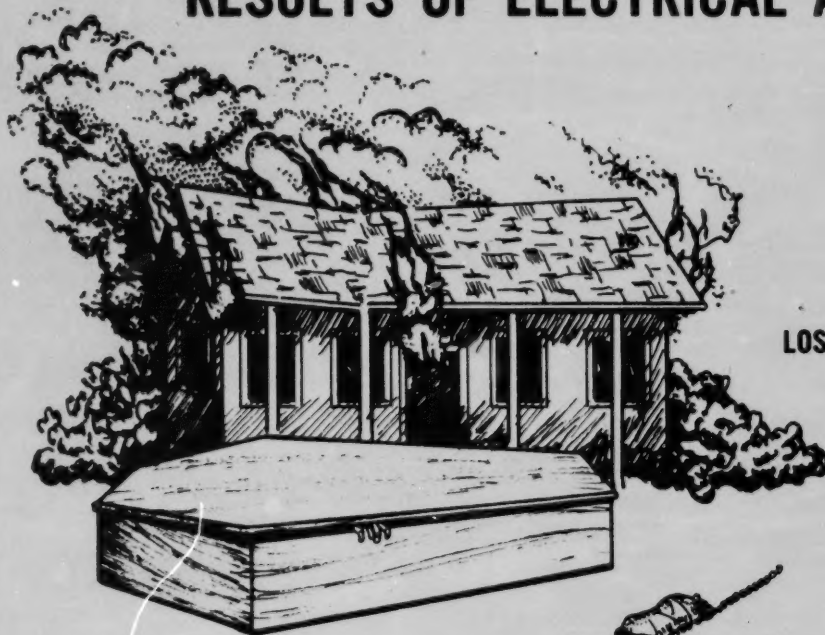
- A. Do not bypass breakers or fuse with "jumpers."
- B. Do not install higher amp-rated fuse or breaker than recommended.
- C. Do not place coins or foil behind a fuse.
- D. Do not overload a circuit.

EFFECTS OF ELECTRICAL ACCIDENTS



TM-1

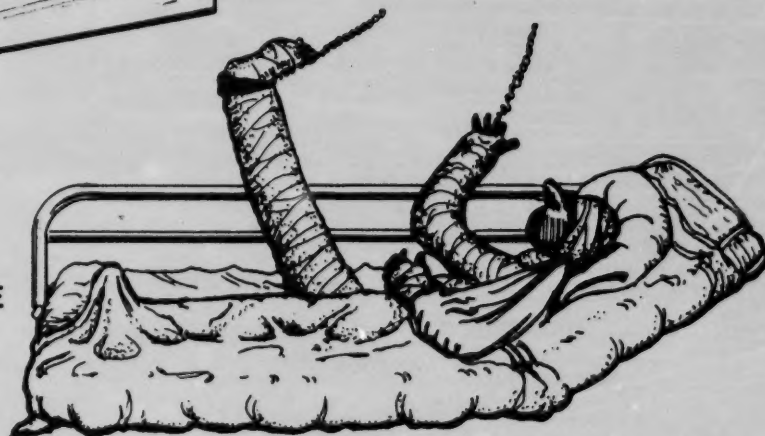
RESULTS OF ELECTRICAL ACCIDENTS



LOSS OF MATERIAL

DEATH

LOSS OF TIME

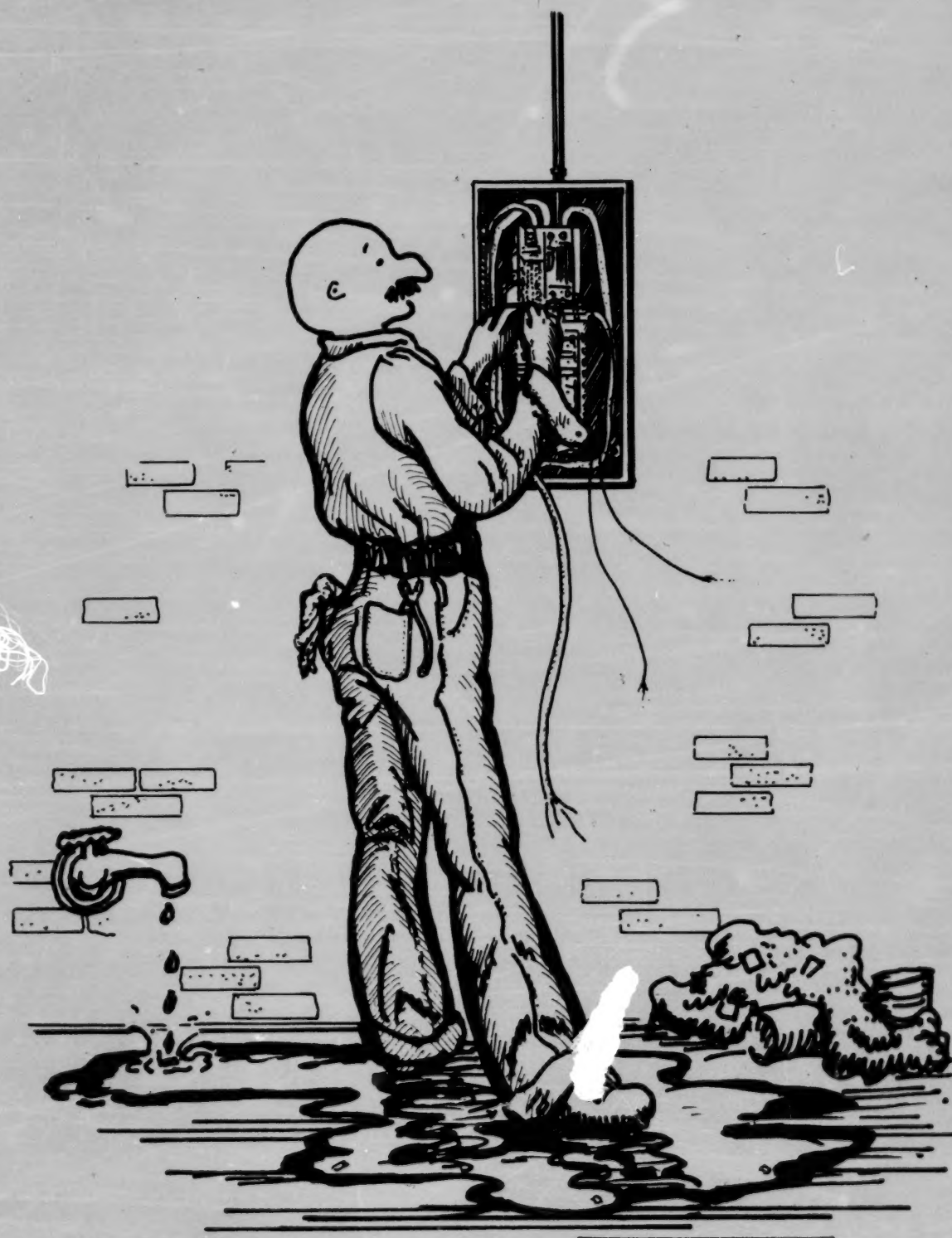


LOSS OF JOB

CRIPPLING



HUMAN FAILURE



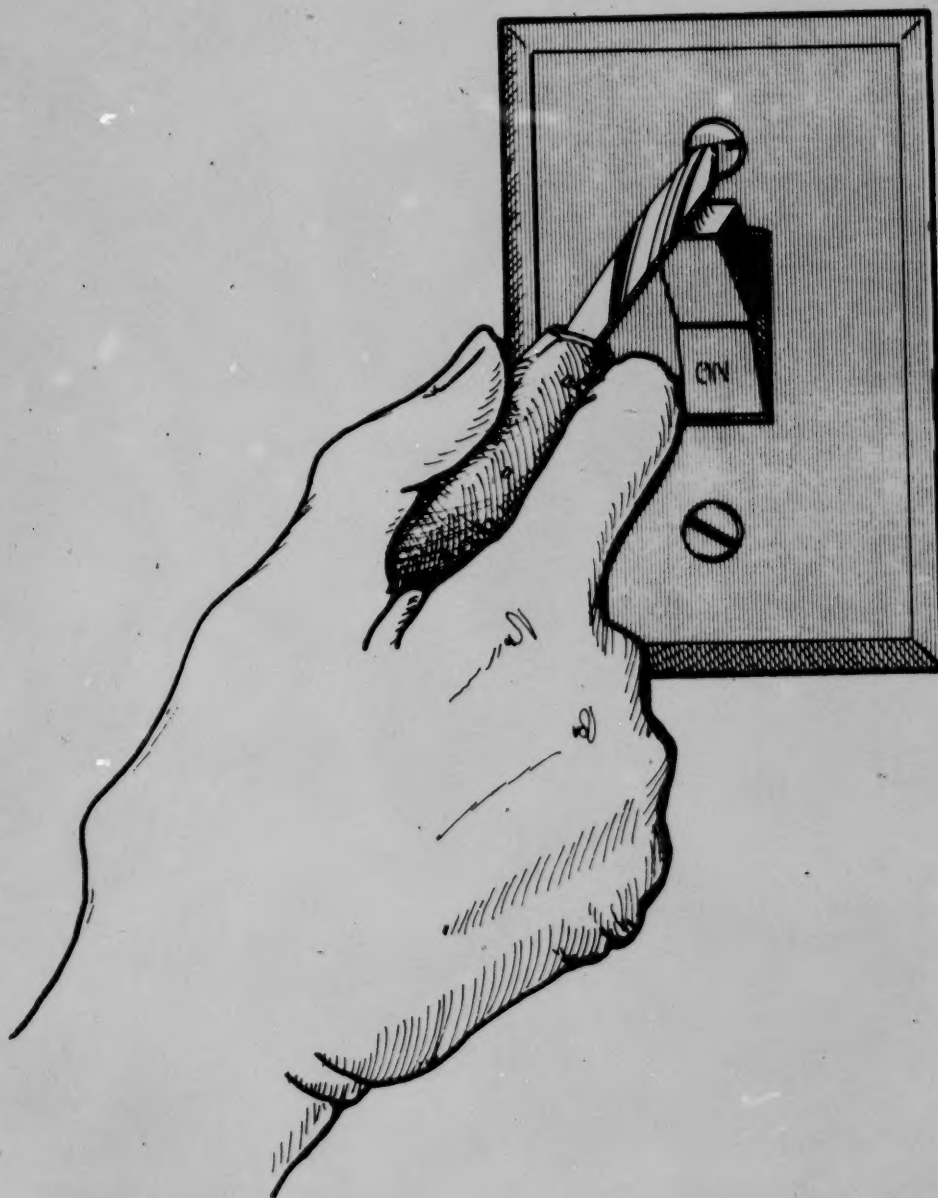
FAILURE



CARELESSNESS



MISUSE



ELECTRICAL SHOCK VICTIMS



USE A NON-CONDUCTOR (NEWSPAPER, STICK, RUBBER HOSE) TO REMOVE A LIVE WIRE FROM A PERSON.

230

TYPES OF FIRE EXTINGUISHERS



SODA-ACID



**PRESSURIZED
WATER**



FOAM



**CARBON
DIOXIDE**



**DRY
CHEMICAL**



CLASS A - Fires that occur in ordinary combustible materials, such as wood, rags, and rubbish.



CLASS B - Fires that occur with flammable liquids, such as gasoline, oil, paints, and thinners.



CLASS C - Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring.

WORK AREA SAFETY



UNIT II

ELECTRICAL SAFETY

ASSIGNMENT SHEET #1--SAFETY SURVEY

Directions: Survey the shop and classroom for any unsafe electrical conditions. List any hazards you find. Be sure to check all wall outlets, switches, motors, tools, and extension cords. Your survey will be used to help make the shop and classroom a safer place in which to learn.

UNIT II
ELECTRICAL SAFETY

ASSIGNMENT SHEET #2--SAFETY INSPECTION

Directions: Visually inspect your home and garage for unsafe electrical conditions. Record any unsafe condition you find and bring to class for discussion. The following items are some areas you may want to check.

1. Extension cords hung over nails
2. Worn or frayed electrical cords
3. Switches not working properly
4. Light bulbs near flammable materials
5. Outlets overloaded
6. Electrical cords under rugs or on floor in traffic areas
7. Television set near flammable material
8. Outlets in poor condition with no covers
9. Fuse box for improper fuses
10. Appliances not grounded
11. Main switch hard to reach

UNIT II
ELECTRICAL SAFETY

ASSIGNMENT SHEET #3--IDENTIFY FIVE TYPES OF
FIRE EXTINGUISHERS

Directions: Identify the five types of fire extinguishers shown below using Part VII of the Information Sheet and Transparency #8. Write the name of each in the blanks.



a. _____



b. _____



c. _____



d. _____



e. _____

UNIT II

ELECTRICAL SAFETY

ASSIGNMENT SHEET #4--PREPARE ELECTRICAL SAFETY POSTER

Directions: On a piece of poster board or a sheet of typing paper, prepare a poster about electrical safety. You may want to use some of the rules listed in the Information Sheet for ideas in making your poster.

(Note: The instructor may want to display your poster as a safety reminder.)

UNIT II
ELECTRICAL SAFETY

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Evaluated to the satisfaction of the instructor

Assignment Sheet #2

Evaluated to the satisfaction of the instructor

Assignment Sheet #3

- a. Soda-acid
- b. Pressurized water
- c. Foam
- d. Carbon dioxide
- e. Dry chemical

Assignment Sheet #4

Evaluated to the satisfaction of the instructor

UNIT II
ELECTRICAL SAFETY

UNIT TEST

1. Match the electrical safety terms in the right hand column to the correct definition on the left by placing the number in the blank.

- | | | |
|----------|--|----------------------|
| _____ a. | The result of electrical discharge through a person's body | 1. Accident |
| _____ b. | Any sudden, unintentional event which causes injury or property damage | 2. Safety |
| _____ c. | State or condition of being safe, free from danger, risk or injury | 3. Electrical shock |
| _____ d. | A connection to the earth which serves as a return circuit and reduces danger | 4. Defective |
| _____ e. | Not in proper working order | 5. Approved |
| _____ f. | Current-carrying wire | 6. Ground |
| _____ g. | A disconnected circuit | 7. Short circuit |
| _____ h. | Improper connection between hot wires or between hot and neutral wires | 8. Overload |
| _____ i. | Minimum standards set by authorities have been met | 9. Live wire |
| _____ j. | A circuit or device forced to carry more electrical current than design allows | 10. Dead circuit |
| | | 11. Modification |
| | | 12. Qualified person |

2. List four results of electrical accidents.

A.

B.

C.

D.

3. Identify the effects of electrical accidents by placing a "✓" in the blank beside the terms which apply.

_____ A. Death

_____ B. Crippling

_____ C. Loss of time

_____ D. Loss of material

_____ E. Loss of job

4. Point out the common causes of electrical accidents by writing the number of each term on the right in the correct blank on the left.

_____ a. Not using safe work practices

_____ b. Using something in an improper manner

_____ c. Not making necessary repairs

_____ d. Not observing safety rules

_____ e. Ground wire missing

_____ f. Broken handle

_____ g. Not knowing proper procedure

1. Ignorance

2. Defective equipment

3. Failure

4. Carelessness

5. Modification

6. Human failure

7. Defective tool

8. Misuse

5. Point out the proper procedures for helping an electrical shock victim by placing a "✓" in the blank beside the correct statements only.
- ☐ A. Turn off electricity causing shock.
 - ☐ B. Remove hot wire from victim, using a metal rod.
 - ☐ C. Administer mouth-to-mouth resuscitation.
 - ☐ D. Call an ambulance or doctor.
 - ☐ E. Notify gas company.
 - ☐ F. Watch for possible electrical fire.
6. List three classes of fires.
- A.
 - B.
 - C.
7. Determine for what class or classes of fire each of the following types of extinguishers may be used.
- | | | |
|----------------------|-------|--------------------------|
| A. Soda-acid | Class | ☐ |
| B. Pressurized water | " | ☐ |
| C. Foam | " | ☐ |
| D. Carbon dioxide | " | ☐ |
| E. Dry chemical | " | ☐ |
8. Select the correct work area safety factors by placing a "✓" in the blank beside the correct statement only.
- ☐ A. Work area must be free of loose tools.
 - ☐ B. Keep loose material in work area.
 - ☐ C. Floors must be free of oil, water, grease and other liquids.
 - ☐ D. Work only on live circuits.
 - ☐ E. Keep good housekeeping and work habits.

9. Identify the correct tool and equipment safety factors by writing either safe or unsafe in each of the blanks below.

- _____ A. Proper operation of equipment
- _____ B. Keep tools greased
- _____ C. Insulate handles
- _____ D. Keep cutting tools sharp
- _____ E. Use the tool most handy

10. Select the correct electrical installation safety factors by placing a "/" in the blank beside the correct statements only.

- _____ A. Check circuit with test light before starting work.
- _____ B. Equipment and tools must be dry.
- _____ C. Work on either side of circuit.
- _____ D. Wear approved hard hat.
- _____ E. Use painted metal ladder.
- _____ F. Cut away from body when stripping wire.

11. Select the correct special precautions in electrical safety by placing a "/" in the blank beside the correct statements only.

- _____ A. Use bypass "jumpers" on breakers and fuses.
- _____ B. Do not install higher amp-rated fuse or breaker than recommended.
- _____ C. If fuse is blown, place coin or foil behind the fuse.
- _____ D. Do not overload a circuit.

12. Demonstrate the ability to

- A. Survey the shop and classroom for unsafe electrical conditions.
- B. Visually inspect your home and garage for unsafe electrical conditions.

C. Identify five types of fire extinguishers.

D. Prepare an electrical safety poster.

(Note: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT II
ELECTRICAL SAFETY

ANSWERS TO UNIT TEST

- | | |
|---------|-------|
| 1. a. 3 | f. 9 |
| b. 1 | g. 10 |
| c. 2 | h. 7 |
| d. 6 | i. 5 |
| e. 4 | j. 8 |

2. A. Shock
B. Burns
C. Falls and/or spills
D. Cuts and/or abrasions

3. ✓ A.
✓ B.
✓ C.
✓ D.
✓ E.

4. a. 6
b. 8
c. 3
d. 4
e. 2
f. 7
g. 1

5. ☒ A.

☐ B.

☒ C.

☒ D.

☐ E.

☒ F.

6. A. Class A

B. Class B

C. Class C

7. A. Class A only

B. Class A only

C. Class A and B

D. Class A, B or C

E. Class A, B or C

8. ☒ A.

☐ B.

☒ C.

☐ D.

☒ E.

9. safe A.

unsafe B.

safe C.

safe D.

unsafe E.

10. ☒ A.

☒ B.

☐ C.

- ☒ D.
☐ E.
☒ F.
11. ☐ A.
☒ B.
☐ C.
☒ D.
12. A. Evaluated to the satisfaction of the instructor
B. Evaluated to the satisfaction of the instructor
C. Evaluated to the satisfaction of the instructor
D. Evaluated to the satisfaction of the instructor

UNIT III

ELECTRICAL TOOLS AND MATERIALS

UNIT OBJECTIVE

After completing this unit, the student will be able to identify electrical tools and materials. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit the student will be able to:

1. Match the terms and definitions associated with electrical tools and materials.
2. Identify five types of wire conductors.
3. Identify types of conduit.
4. Select the types of electrical boxes.
5. Identify the types of electrical connectors.
6. Cite the types of electrical covers.
7. List three types of switches.
8. Cite the types of electrical outlets and receptacles.
9. Identify electrical safety devices.
10. Match electrical tools to their correct name.
11. Select items found in an electrical service entrance.
12. Demonstrate the ability to:
 - a. Select the proper terms for electrical materials.
 - b. Select the correct names for electrical tools.
 - c. List nine major parts of an electrical service entrance.

UNIT III
ELECTRICAL TOOLS AND MATERIALS

SUGGESTED ACTIVITIES

- I. Instructor
 - A. Discuss unit objective.
 - B. Provide students with information and assignment sheets.
 - C. Prepare transparencies and lesson plans.
 - D. Discuss information and assignment sheets.
 - E. Prepare display of sample electrical materials.
 - F. Prepare display of electrical tools.
 - G. Give test.
 - H. Review problem areas identified by test.
- II. Student
 - A. Discuss questions of unit objective.
 - B. Read and discuss information and assignment sheets.
 - C. Complete assignment sheets.
 - D. Take unit test.
 - E. Discuss test questions missed.

INSTRUCTIONAL MATERIALS

- I. Included in this unit:
 - A. Objective sheet
 - B. Information sheet
 - C. Transparency masters
 - 1. TM-1--Types of Wire Conductors
 - 2. TM-2--Types of Conduit

3. TM-3--Types of Electrical Boxes
 4. TM-4--Types of Electrical Connectors
 5. TM-5--Types of Electrical Covers
 6. TM-6--Types of Switches
 7. TM-7--Types of Outlets and Receptacles
 8. TM-8--Types of Electrical Safety Devices
 9. TM-9--Tools Used In Electrical Wiring
 10. TM-10--Screwdrivers
 11. TM-11--Drills and Bits
 12. TM-12--Types of Saws and Hammers
 13. TM-13--Soldering Equipment
 14. TM-14--Measuring Devices
 15. TM-15--Special Tools and Equipment
 16. TM-16--Electrical Service Entrance
- D. Assignment sheets
1. Assignment Sheet #1--Identify Electrical Materials
 2. Assignment Sheet #2--Identify Electrical Tools
 3. Assignment Sheet #3--Identify Service Entrance Parts

E. Unit test

F. Answers to unit test

II. References:

- A. Mix, Floyd. House Wiring Simplified. South Holland, Illinois: Goodheart-Wilcox Co., Inc. 1973.
- B. General Construction Trades. Stillwater, Okla.: State Department of Vocational and Technical Education, 1971.

- C. Electricity. Construction Industry Series
Student Manual. Austin, Texas: Texas Education
Agency, 1975.

UNIT III
ELECTRICAL TOOLS AND MATERIALS

INFORMATION SHEET

- I. Terms and definitions
 - A. Conduit--Metal or plastic pipe used to enclose conductors
 - B. Outlet--Place in wiring system where appliances may be attached to the receptacle
 - C. Receptacle--Device installed at the outlet for a connection of appliances
 - D. Duplex--Double receptacle
- II. Types of wire conductors (TM-1)
 - A. Nonmetallic cable (NM)
 - B. Thermal wire cable (TW)
 - C. Metallic armored cable (BX)
 - D. Power service cord (SJ)
 - E. Lamp cord (rubber or braided insulation)
- III. Types of conduit (TM-2)
 - A. Thinwall (EMT)
 - B. Rigid
 - C. Flexible
- IV. Types of electrical boxes (TM-3)
 - A. Octagonal ceiling or junction
 - B. Rectangular wall switch or outlet
 - C. Surface mounted
 - D. Special
 - 1. Waterproof
 - 2. Shallow

V. Types of electrical connectors (TM-4)

A. Conduit connectors

1. Indenter type
2. Compression type
3. Coupler
4. NM wire connector

B. Conductor connectors

1. Wire nuts
2. Soldered and taped

VI. Types of electrical covers (plastic or metal) (TM-5)

- A. Duplex receptacle
- B. Toggle switch
- C. Combination duplex and switch
- D. Specialty

VII. Types of switches (TM-6)

- A. Single pole
- B. Three-way
- C. Mechanical quiet
- D. Mercury

VIII. Types of outlets and receptacles (TM-7)

- A. Duplex without ground
- B. Duplex with ground
- C. 208-240V
- D. Surface mount 240V
- E. Weatherproof

IX. Types of electrical safety devices (TM-8).

- A. Fuses

1. Plug
2. Blade
3. Cartridge

B. Circuit breaker

X. Tools used in electrical wiring (TM-9)

A. Pliers

1. Slip joint
2. Lineman
3. Diagonal cutter
(Note: Often called "dikes")
4. Long nose
5. End cutter
6. Channellock
7. Vise-grip

B. Screwdrivers (TM-10)

1. Straight slot
2. Phillips point
3. Stubby
4. Screwdriver bit

C. Drills and bits (TM-11)

1. Drills
 - a. Power
 - b. Bit brace
 - c. Hand drill
2. Bits
 - a. Augur
 - b. Wood twist

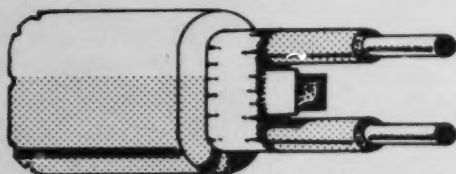
- c. Expansive
- d. Twist drill
- e. Masonry
- f. Star drill
- D. Types of saws (TM-12)
 - 1. Crosscut hand
 - 2. Keyhole
 - 3. Hack
 - 4. Power hand or circular
- E. Hammers
 - 1. Claw
 - 2. Lineman
 - 3. Ball peen
- F. Soldering equipment (TM-13)
 - 1. Soldering iron
 - 2. Soldering gun
 - 3. Propane torch
 - 4. Solder
 - 5. Soldering paste
- G. Measuring devices (TM-14)
 - 1. 6-to 12-foot push-pull tape
 - 2. 50-to 100-foot steel tape
 - 3. Folding rule
- H. Special tools and equipment (TM-15)
 - 1. Equipment for wire pulling
 - a. Steel fish tape
 - b. Polyethylene fish tape

- c. Wire pulling lubricant
- 2. Special electrical tools
 - a. Pipe cutter
 - b. Test light
 - c. Conduit bender
 - d. Wood chisel
 - e. Wire stripper
 - f. Utility knife

XI. Electrical service entrance (TM-16)

- A. Lead wires
- B. Entrance head
- C. Meter box
- D. Entrance ell
- E. Neutral bar
- F. Single-pole breaker
- G. Two-pole breaker
- H. Main breaker
- I. Panel

TYPES OF WIRE CONDUCTORS



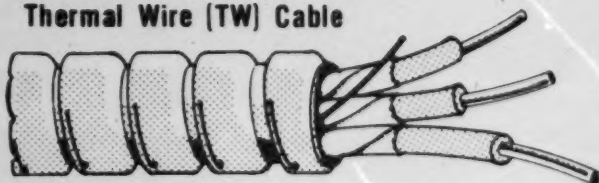
Non-metallic (NM) Cable Without Ground



Non-metallic (NM) Cable With Ground



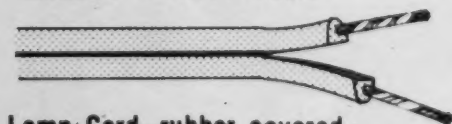
Thermal Wire (TW) Cable



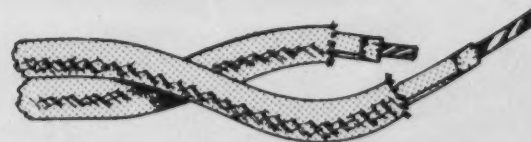
Metallic Armored Cable



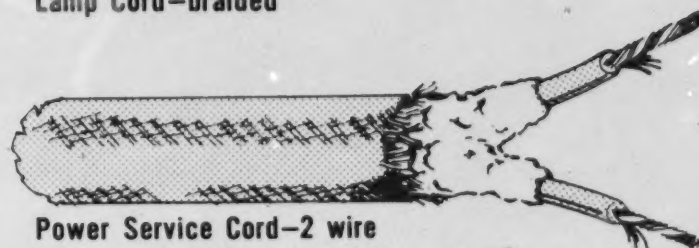
Metallic Armored Cable



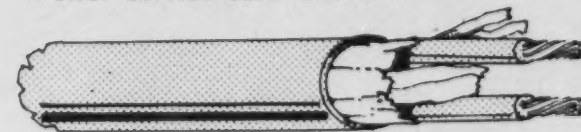
Lamp Cord-rubber covered



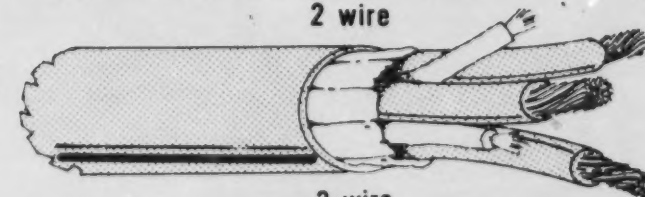
Lamp Cord-braided



Power Service Cord-2 wire

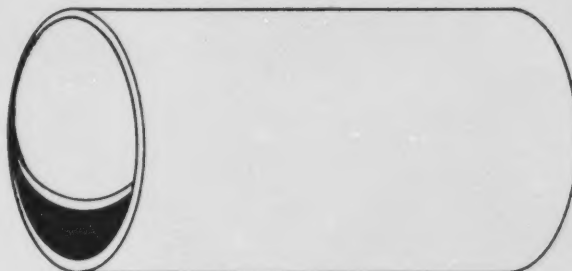


2 wire



3 wire

TYPES OF CONDUIT



Thin Wall Conduit

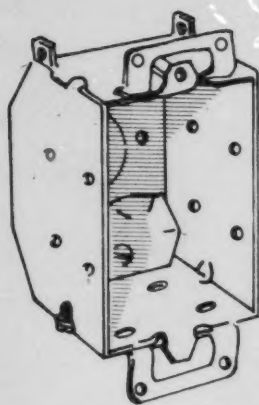


Rigid Conduit

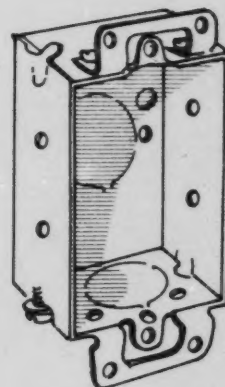


Flexible Conduit

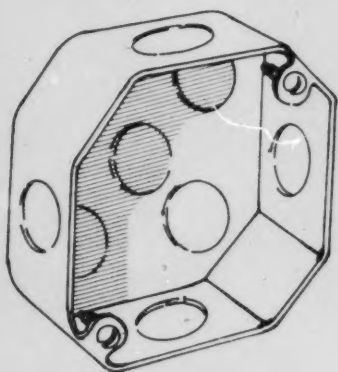
TYPES OF ELECTRICAL BOXES



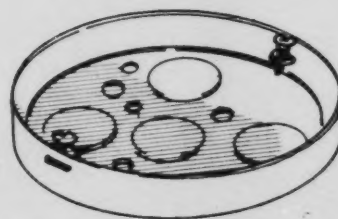
Shallow Boxes



Rectangular Switch or Outlet Box

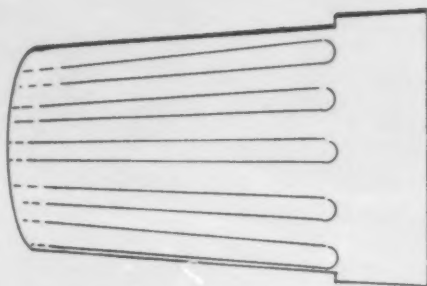


Octagon Box

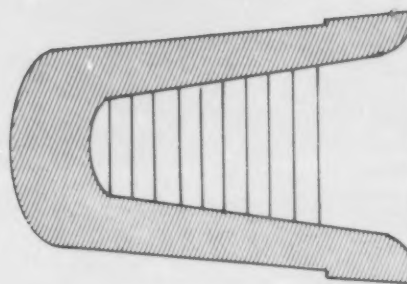


Surface Mount Box

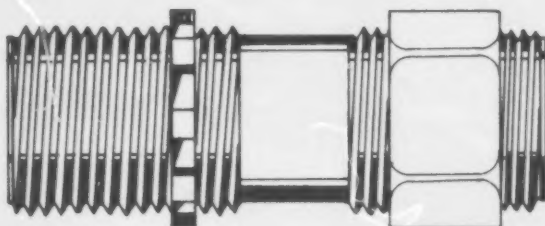
TYPES OF ELECTRICAL CONNECTORS



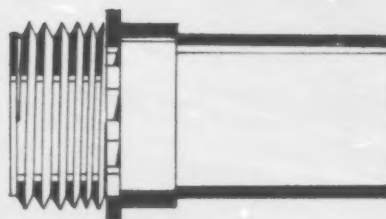
Wire Nut



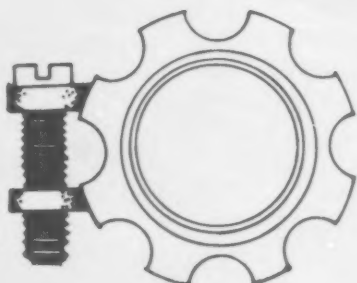
NM Wire Connector



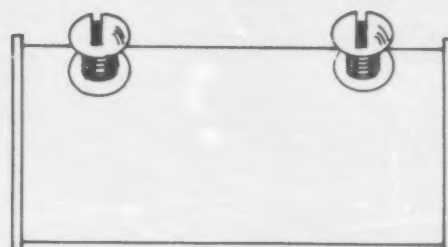
Compression Type Connector



Indenter Connectors

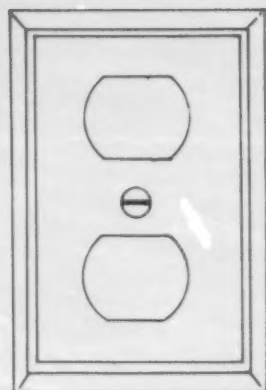


CONNECTOR

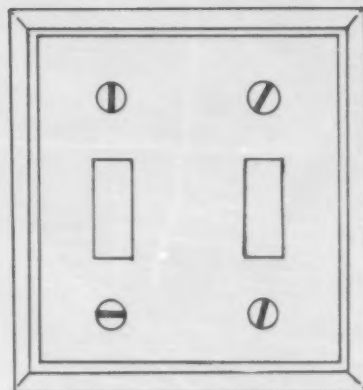


Coupler

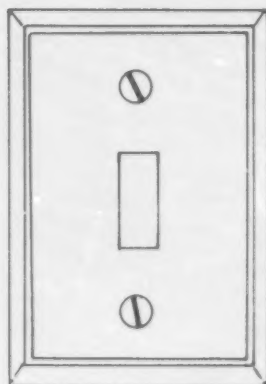
TYPES OF ELECTRICAL COVERS



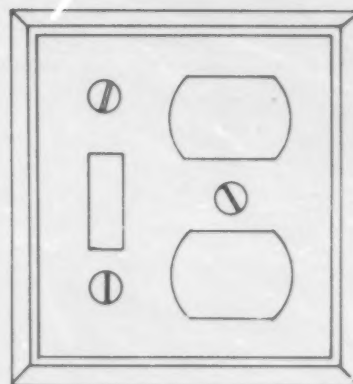
Duplex Receptacle Cover



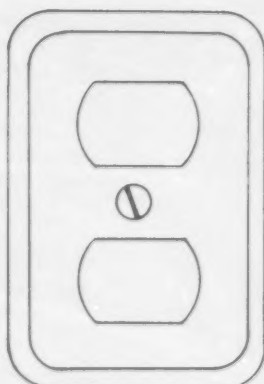
Double Switch Cover



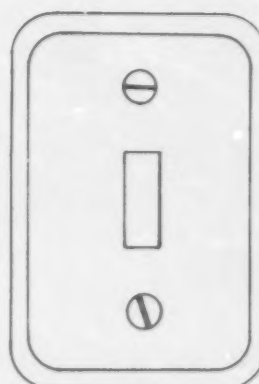
Single Switch Cover



Combination Switch and Duplex

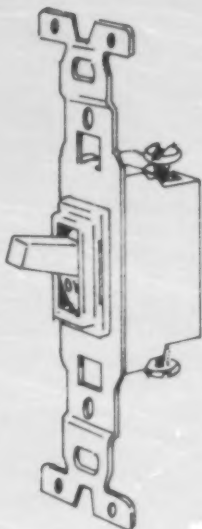


Metal Duplex Cover

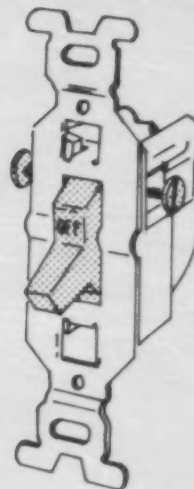


Metal Switch Cover

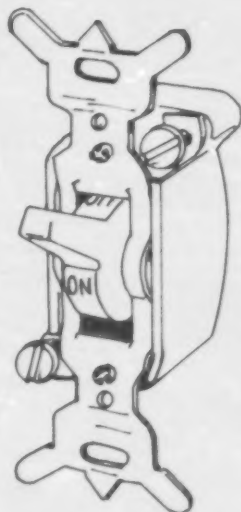
TYPES OF SWITCHES



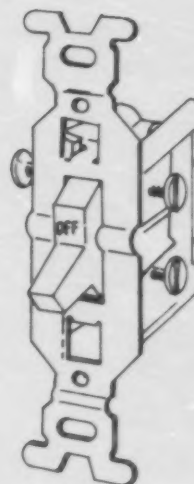
Single Pole Quiet Switch



Single Pole Switch

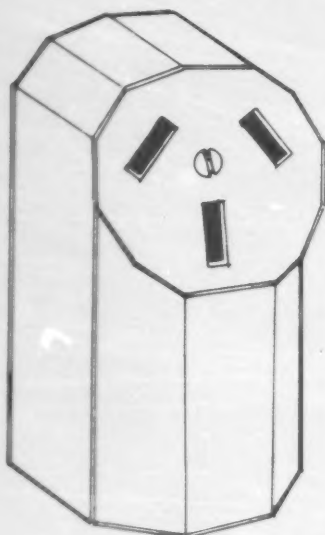


Single Pole Mercury Switch

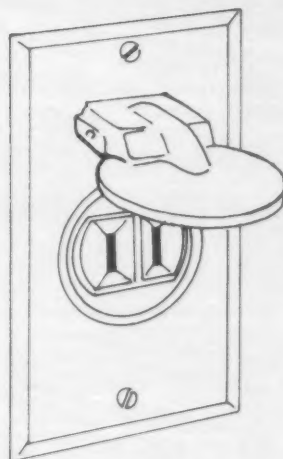


Three Way Switch

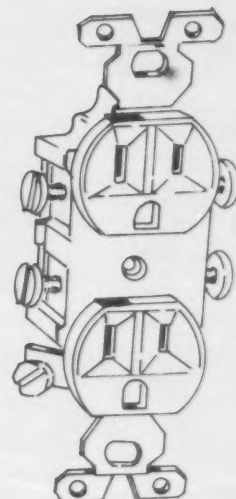
TYPES OF OUTLETS AND RECEPTACLES



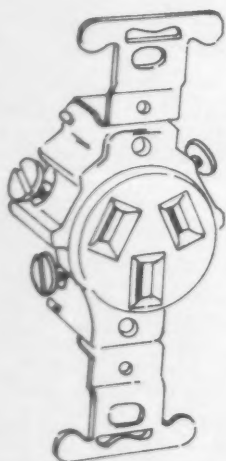
50 Amp Outlet



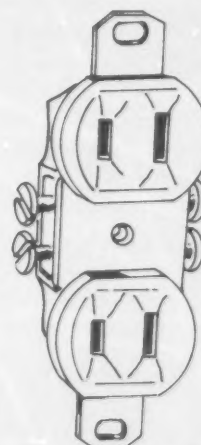
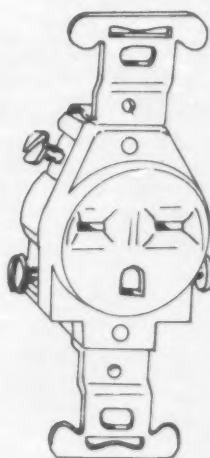
Weatherproof receptacle



**Duplex Outlet With
Grounding Terminal**



208-240 Volt Outlets



**Duplex Outlet Without
Grounding Terminal**

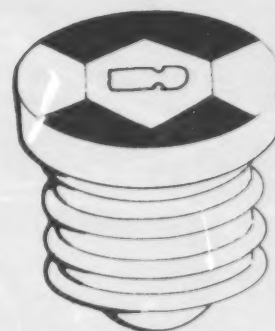
TYPES OF ELECTRICAL SAFETY DEVICES



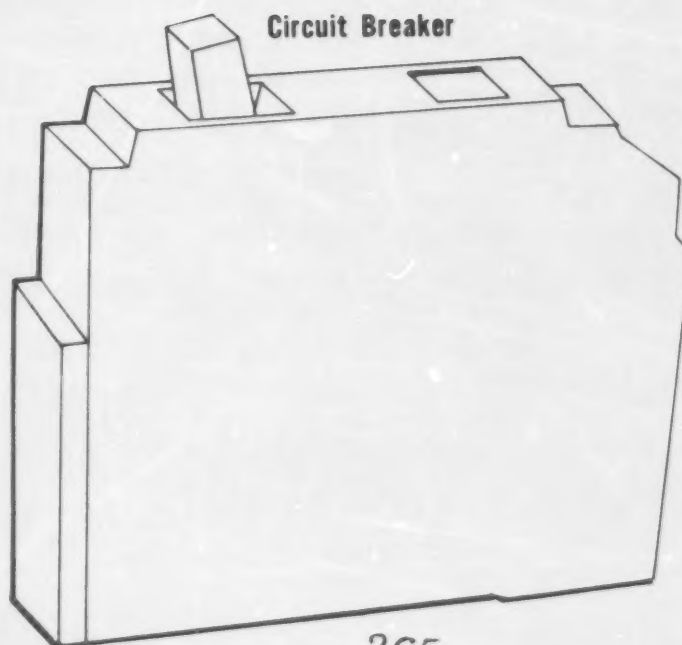
Blade



Cartridge

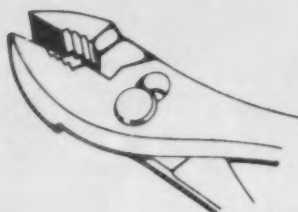


Plug

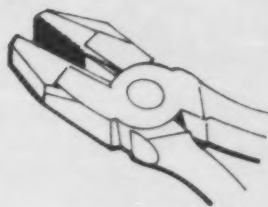


Circuit Breaker

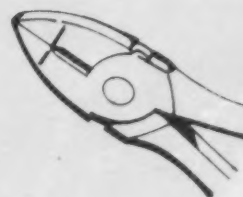
TOOLS USED IN ELECTRICAL WIRING



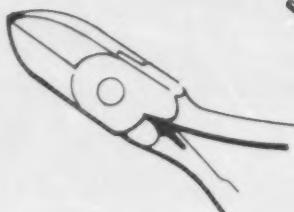
Slip Joint



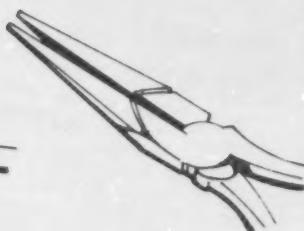
Lineman's



Side Cutting



Diagonal Cutting



Long Nose



Chain Nose



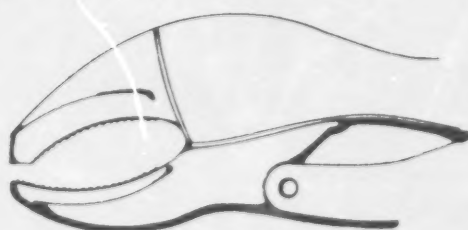
**High Leverage
End Cutting**



**Oblique Cutting
With Skinning Holes**

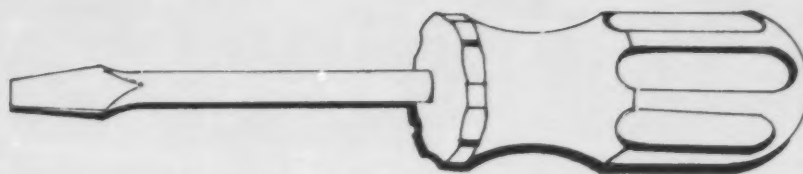


Curved Jaw

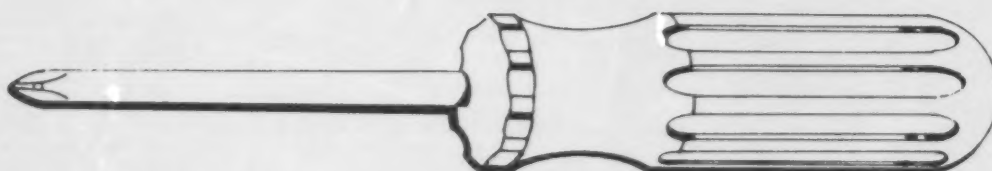


Vice-grips

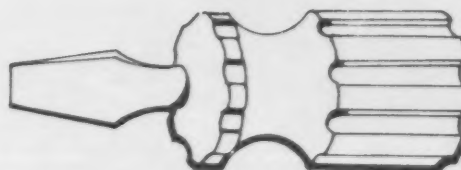
SCREWDRIVERS



Conventional Straight Shank



Phillips



Stub or Close Quarter



Screwdriver Bit

DRILLS AND BITS

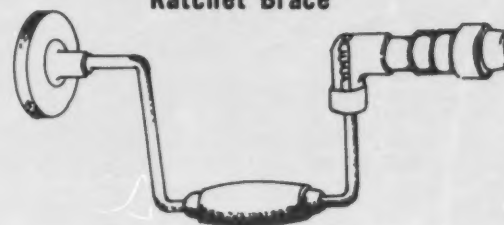
Masonry Bit



Twist Drill



Ratchet Brace



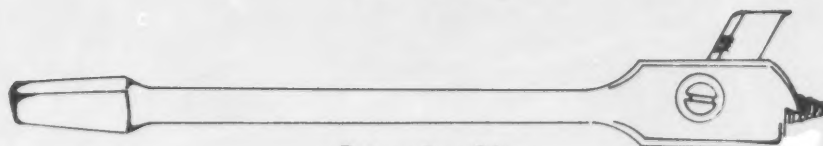
Star Drills



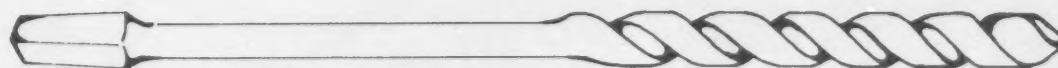
Auger Bit



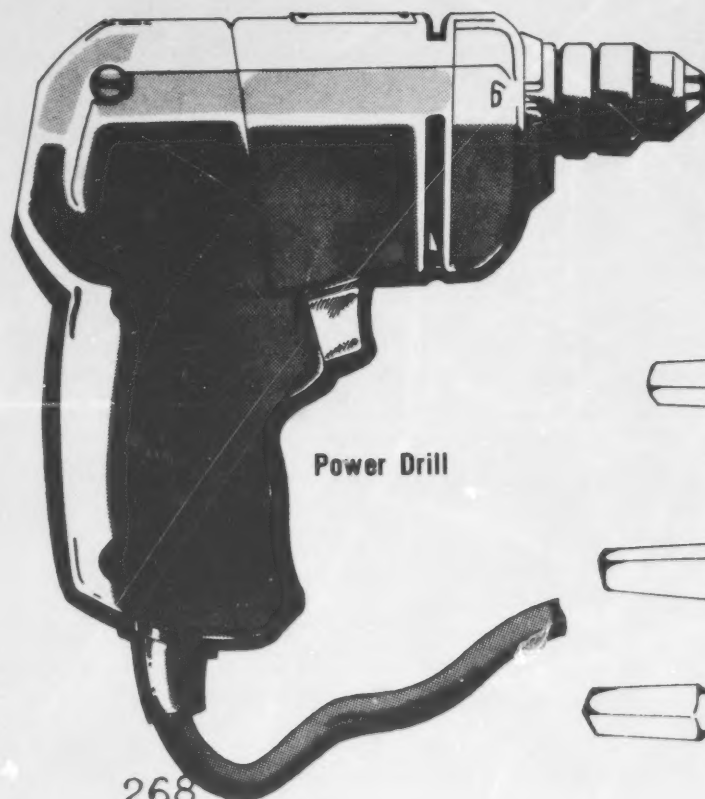
Expansive Bit



Wood Twist Bit

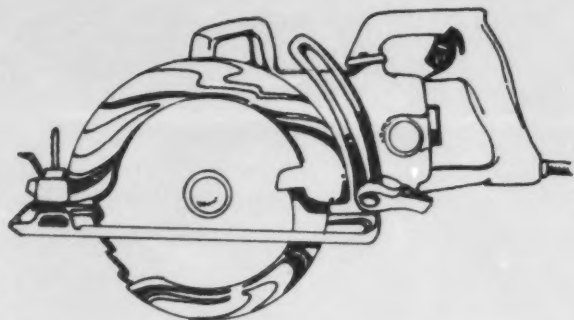


Power Drill

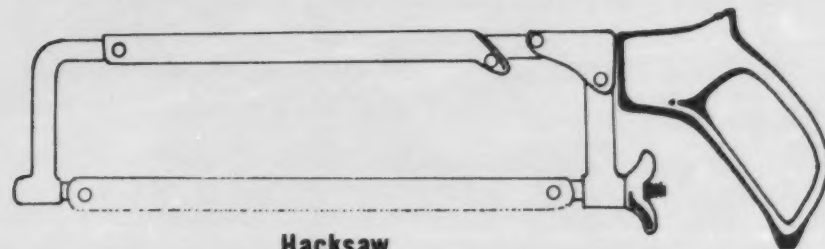


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TYPES OF SAWS AND HAMMERS



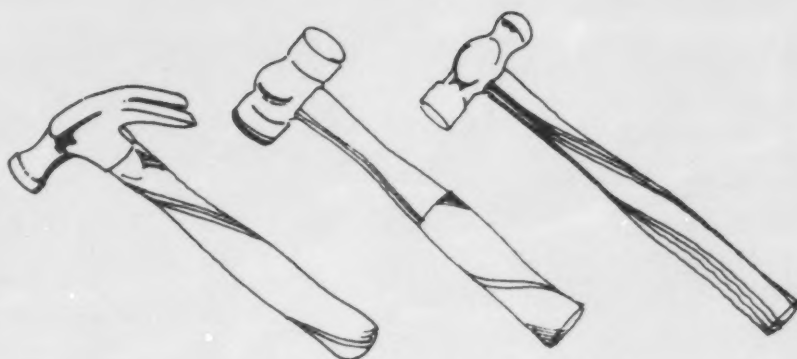
Power Saw



Hacksaw



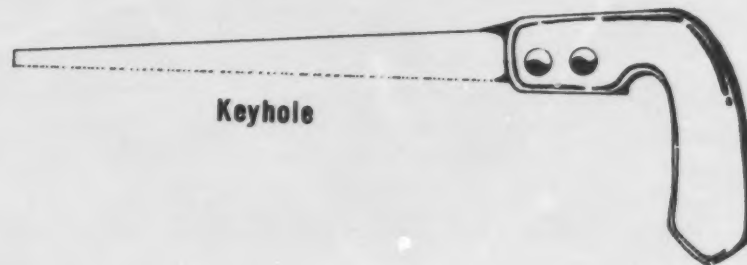
Cross Cut



Claw Hammer

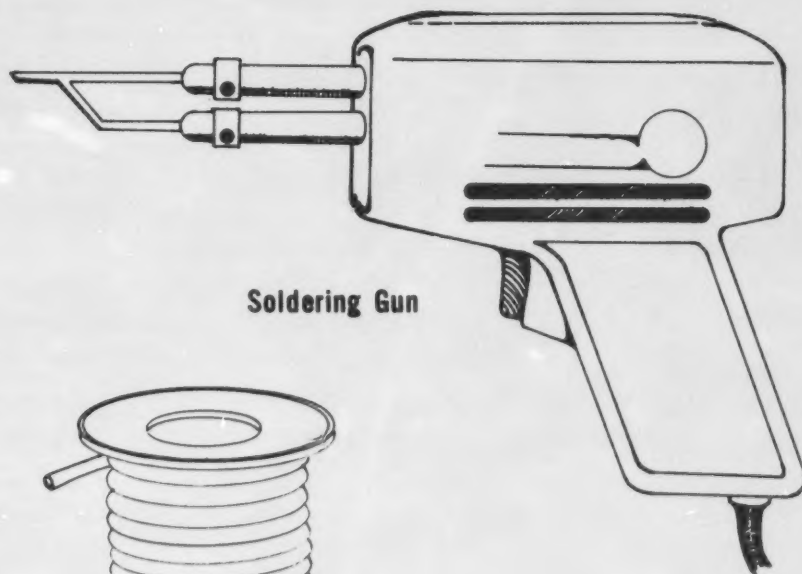
Lineman's Hammer

Ball Peen Hammer



Keyhole

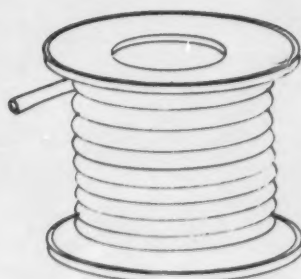
SOLDERING EQUIPMENT



Soldering Gun



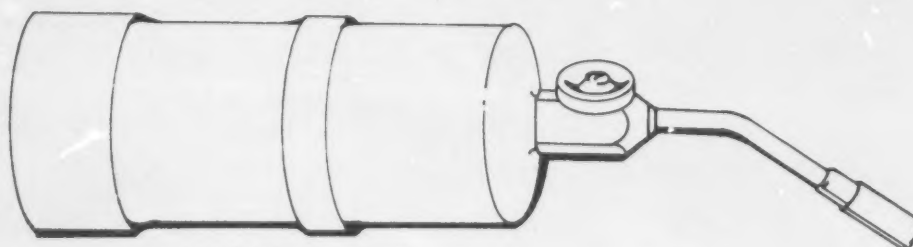
Soldering Paste



Solder



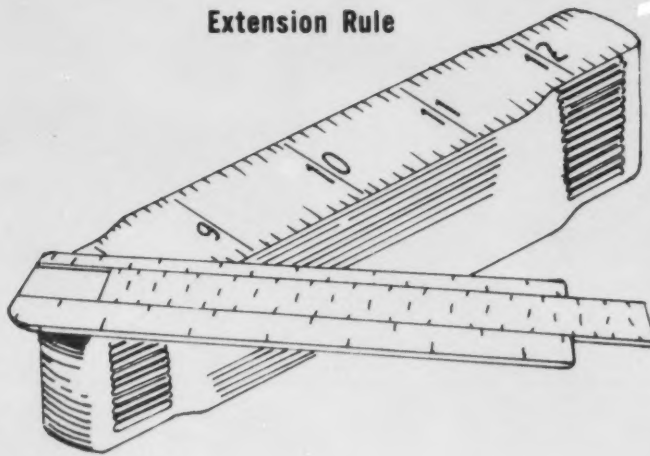
Electric Soldering Iron



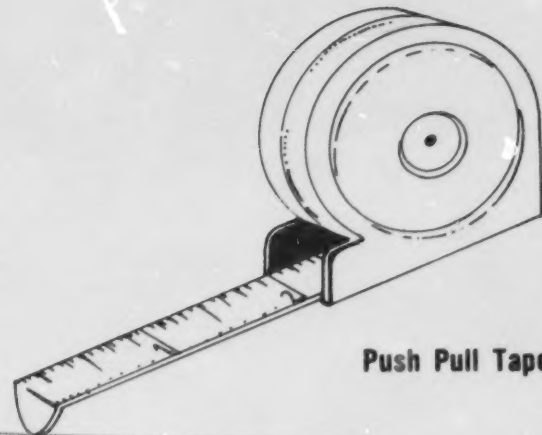
Propane Torch

MEASURING DEVICES

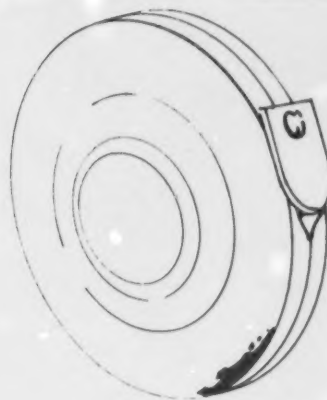
Extension Rule



Push Pull Tape Rule



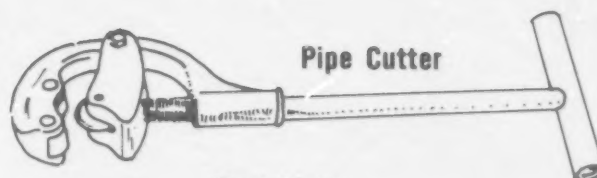
Steel Tape



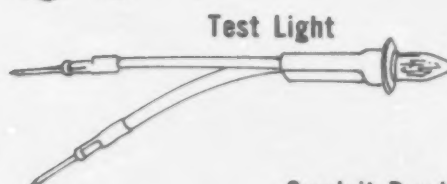
SPECIAL TOOLS AND EQUIPMENT



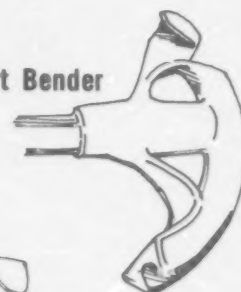
Polyethylene Fish Tape



Pipe Cutter



Test Light



Conduit Bender



Wire Pulling Lubricant



Wood Chisel



Wire Stripper

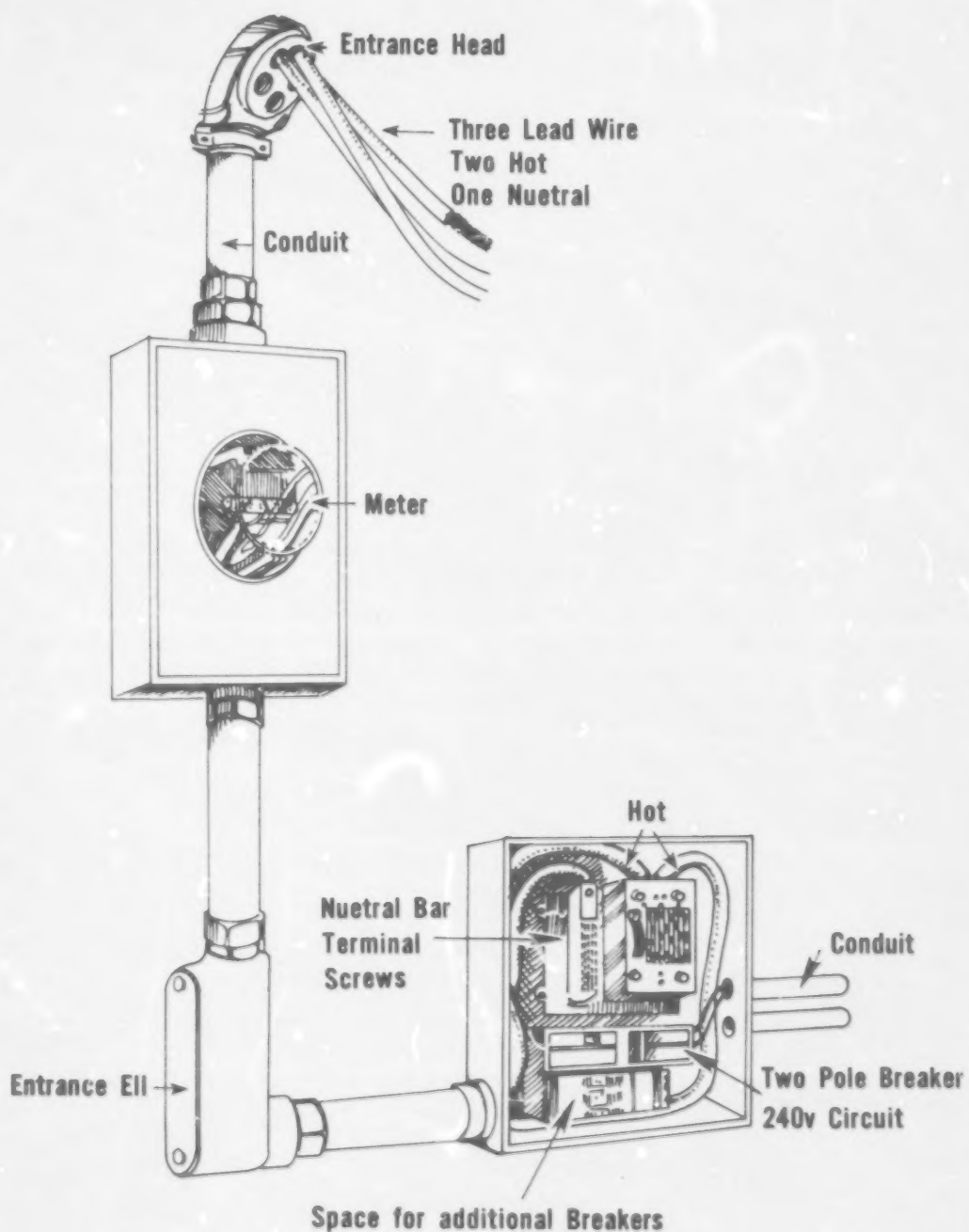


Steel Fish Tape Reel and Puller



Utility Knife

ELECTRICAL SERVICE ENTRANCE



UNIT III

ELECTRICAL TOOLS AND MATERIALS

ASSIGNMENT SHEET #1--IDENTIFY ELECTRICAL MATERIALS

Directions: The instructor will prepare a display with a sample of each material listed in Part II. Each item will be assigned a number only. On a sheet of paper, write the correct name of each item beside the number of that item. (Note: The instructor may provide a list of basic electrical material terms from which you can select your answers.)

UNIT III

ELECTRICAL TOOLS AND MATERIALS

ASSIGNMENT SHEET #2--IDENTIFY ELECTRICAL TOOLS

Directions: The instructor will prepare a display of each tool listed in Part 2 of the Information Sheet. Each tool will be assigned a number only. On a sheet of paper, write the correct name of each tool beside the number of that tool. (Note: The instructor may provide a list of electrical tools from which you can select your answers.)

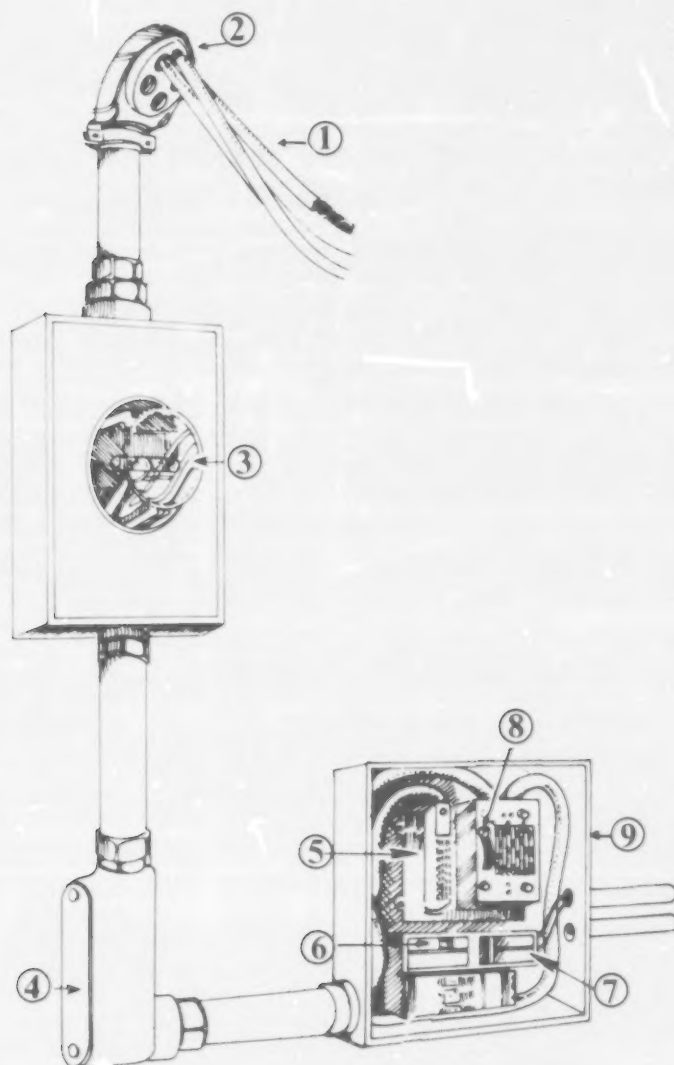
UNIT III

ELECTRICAL TOOLS AND MATERIALS

ASSIGNMENT SHEET #3--IDENTIFY ELECTRICAL
SERVICE ENTRANCE PARTS

Directions: Using the illustration below and the information sheet identify nine major parts of an electrical service entrance by listing them below.

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.



UNIT III
ELECTRICAL TOOLS AND MATERIALS

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Evaluated to the satisfaction of the instructor.

Assignment Sheet #2

Evaluated to the satisfaction of the instructor.

Assignment Sheet #3

1. Lead wires
2. Entrance head
3. Meter box
4. Entrance ell
5. Neutral bar
6. Single-pole breaker
7. Two-pole breaker
8. Main breaker
9. Panel

UNIT III

ELECTRICAL TOOLS AND MATERIALS

UNIT TEST

1. Match the electrical terms on the right to the correct definition on the left by placing the number in the blank.

- | | |
|--|---------------|
| ___ a. Place in wiring system where appliances may be attached to the receptacle | 1. Outlet |
| ___ b. Metal or plastic pipe used to enclose conductors | 2. Conduit |
| ___ c. Device installed at outlet for connection of appliances | 3. Receptacle |
| ___ d. Double receptacle | 4. Adapter |
| | 5. Conductor |
| | 6. Duplex |

2. Identify the correct types of wire conductors by placing a "✓" in the blank beside the proper terms only.

- ___ a. Metallic armored cable (BX)
- ___ b. Thermal wire cable (TW)
- ___ c. Nonmetallic cable (NM)
- ___ d. Power service cord (SJ)
- ___ e. Lamp cord (rubber or braided insulation)

3. Identify the correct types of conduit by placing a "✓" in the blank beside the proper terms only.

- ___ a. Rigid
- ___ b. Flexible
- ___ c. Thickwall (EMT)
- ___ d. Thinwall (EMT)

4. Select the correct types of electrical boxes by placing a "✓" in the blank beside the proper terms only.

- ☐ a. Rectangular switch or outlet
- ☐ b. Octagonal ceiling or junction
- ☐ c. Sub mounted
- ☐ d. Shallow
- ☐ e. Waterproof

5. Identify the correct types of electrical connectors by placing a "✓" in the blank beside the correct types only.

- ☐ a. Coupler
- ☐ b. Indenter type
- ☐ c. Wire nuts
- ☐ d. Soldered and taped
- ☐ e. Common type

6. Cite the correct types of electrical covers by placing a "✓" beside the correct terms only.

- ☐ a. Duplex
- ☐ b. Toggle switch
- ☐ c. Combination
- ☐ d. Hexagonal
- ☐ e. Specialty

7. List three types of switches.

- a.
- b.
- c.

8. Cite the correct types of electrical outlets and receptacles by placing a "✓" in the blank beside the correct term only.

- ___ a. 208-240V
- ___ b. Duplex with ground
- ___ c. Weatherproof
- ___ d. Shockproof
- ___ e. Duplex without ground

9. Identify which of the following electrical safety devices is a fuse type by placing a "✓" in the blanks beside your choice.

- ___ a. Plug
- ___ b. Blade
- ___ c. Circuit breaker
- ___ d. Cartridge
- ___ e. Insert

10. Match the electrical tools on the left with the names on the right by placing the numbers on the right in the blanks on the left.

___ a.



___ b.



___ c.



- 1. Lineman plier
- 2. Slip-joint plier
- 3. End cutters
- 4. Conduit bender
- 5. Channel lock pliers
- 6. Keyhole saw
- 7. Hack saw
- 8. Stubby screwdriver
- 9. Cold chisel
- 10. Steel tape
- 11. Wood chisel

___ d.



___ e.



___ f.



___ g.



12. Wire stripper

13. Phillips screwdriver

14. Folding rule

15. Fish tape

11. Select from the list below those items found in an electrical service entrance by placing a "✓" in the blank beside the correct answers.

___ a. Neutral bar

___ b. Main breaker

___ c. Three-way switch

___ d. Duplex outlet

___ e. Meter box

___ f. Entrance ell

12. Demonstrate the ability to:

a. Select the proper term for electrical materials.

b. Select the correct name of electrical tools.

c. List nine major parts of an electrical service entrance.

(Note: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT III
ELECTRICAL TOOLS AND MATERIALS

ANSWERS TO UNIT TEST

1. 1 a.
2 b.
3 c.
6 d.

2. ✓ a.
✓ b.
✓ c.
✓ d.
✓ e.

3. ✓ a.
✓ b.
 c.
✓ d.

4. ✓ a.
✓ b.
 c.
✓ d.
✓ e.

5. ✓ a.
✓ b.
✓ c.
✓ d.
 e.

6. ✓ a.
✓ b.
✓ c.
 d.
✓ e.

7. Any three of these four

1. Single pole
2. Three-way
3. Quiet
4. Mercury

8. ✓ a.
✓ b.
✓ c.
 d.
✓ e.

9. ✓ a.
 ✓ b.
 c.
 ✓ d.
 e.

10. 8 a.
 6 b.
 5 c.
 12 d.
 10 e.
 11 f.
 4 g.

11. ✓ a.
 ✓ b.
 c.
 d.
 ✓ e.
 ✓ f.

12. (a-c.) Evaluated to the satisfaction of the instructor

UNIT IV
ELECTRICAL WIRING PROCEDURES

UNIT OBJECTIVE

After completing this unit, the student will be able to use the correct terminology while performing electrical wiring procedures. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with electrical wiring procedures
2. Identify the proper order of wiring procedures
3. Identify the splices and connections used in electrical wiring procedures
4. Identify signs and reasons for wiring failure
5. Demonstrate the ability to:
 - a. Mount electrical boxes
 - b. Install NM cable in electrical boxes
 - c. Install duplex receptacles
 - d. Install single-pole switches
 - e. Install 3-way switches

UNIT IV
ELECTRICAL WIRING PROCEDURES

SUGGESTED ACTIVITIES

I. Instructor:

- A. Discuss unit objective
- B. Provide students with information and job sheets
- C. Prepare transparencies and lesson plans
- D. Prepare material necessary to complete job sheets
- E. Discuss information and job sheets
- F. Give test
- G. Review problem areas identified by test

II. Student:

- A. Discuss questions on unit objective
- B. Read and discuss information and job sheets
- C. Complete job sheets
- D. Take unit test
- E. Discuss test questions missed

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective Sheet
- B. Information Sheet
- C. Transparency masters
 - 1. IV-TM-1--Wiring Plan
 - 2. IV-TM-2--Branch Circuit
- D. Job sheets
 - 1. Job Sheet #1--Mount Electrical Boxes

2. Job Sheet #2--Install NM Cable In Electrical Boxes
3. Job Sheet #3--Install Duplex Receptacle
4. Job Sheet #4--Install Single-Pole Switch
5. Job Sheet #5--Install 3-way switch

E. Unit test

F. Answers to unit test

II. References:

- A. Mix, Floyd. House Wiring Simplified. South Holland, Illinois: Goodheart-Wilcox Company, Inc., 1973.
- B. General Construction Trades. State Department of Vocational and Technical Education, Stillwater, Oklahoma, 1971.

UNIT IV

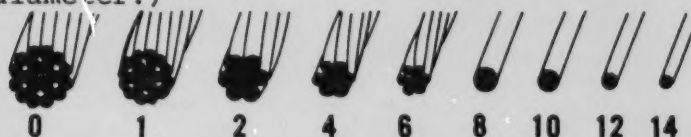
ELECTRICAL WIRING PROCEDURES

INFORMATION SHEET

I. Terms and definitions

- A. Wire--A single conductor
- B. Electrical cable--Two or more wires put together inside an insulating cover
- C. Cord--Several small wires put together in an insulating cover and is usually very flexible
- D. Wire size--Measure of wire diameter and called the "gauge" of wire
- E. Wire gauge number--The number that determines the size of the wire from 4/0 to 14

(Note: The smaller the number the larger the wire diameter.)



- F. Ground wire--Usually bare or green wire that connects circuit to earth for safety
- G. Hot wire--Usually black but can be any color except green and always has voltage applied to it
(Caution: Assume all wires to be hot when checking a circuit.)
- H. Neutral wire--Usually white and serves as a return for current
- I. Junction box--A covered outlet box used to enclose splices within a circuit
- J. Outlet box--A box used to bring the wires to a switch, receptacle, or light
- K. Terminal--A connection between the wires and electrical devices usually fastened with a screw or clip
- L. Duplex receptacle--A contact device that is

installed at an outlet for connection of two single plugs

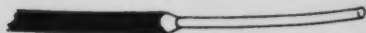
- M. Single pole switch--A switch that controls a circuit in one place
- N. Three-way switch--A switch to control a circuit in two places
- O. Wiring plan--A drawing of the house floor plan showing wiring switches and outlet locations (Transparency #1)
- P. Branch circuit--All the outlets and receptacles connected on any one breaker and commonly called a "leg" (Transparency #2)

II. Three-step wiring procedure

- A. Draw wiring plan
- B. Determine "legs" or branch circuits
- D. Install wires and devices according to wiring plan

III. Splices and connections

- A. Insulation removal



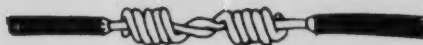
- B. Terminal loop



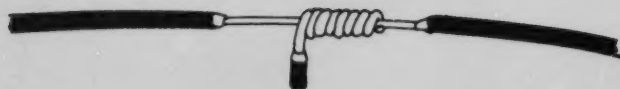
- C. Solderless connection using wire nut



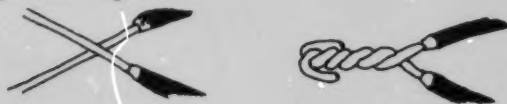
- D. Splicing two wires



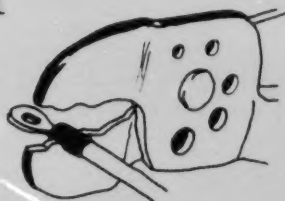
E. Tap splice



F. Pigtail splice



G. Solderless terminal



IV. Poor wiring

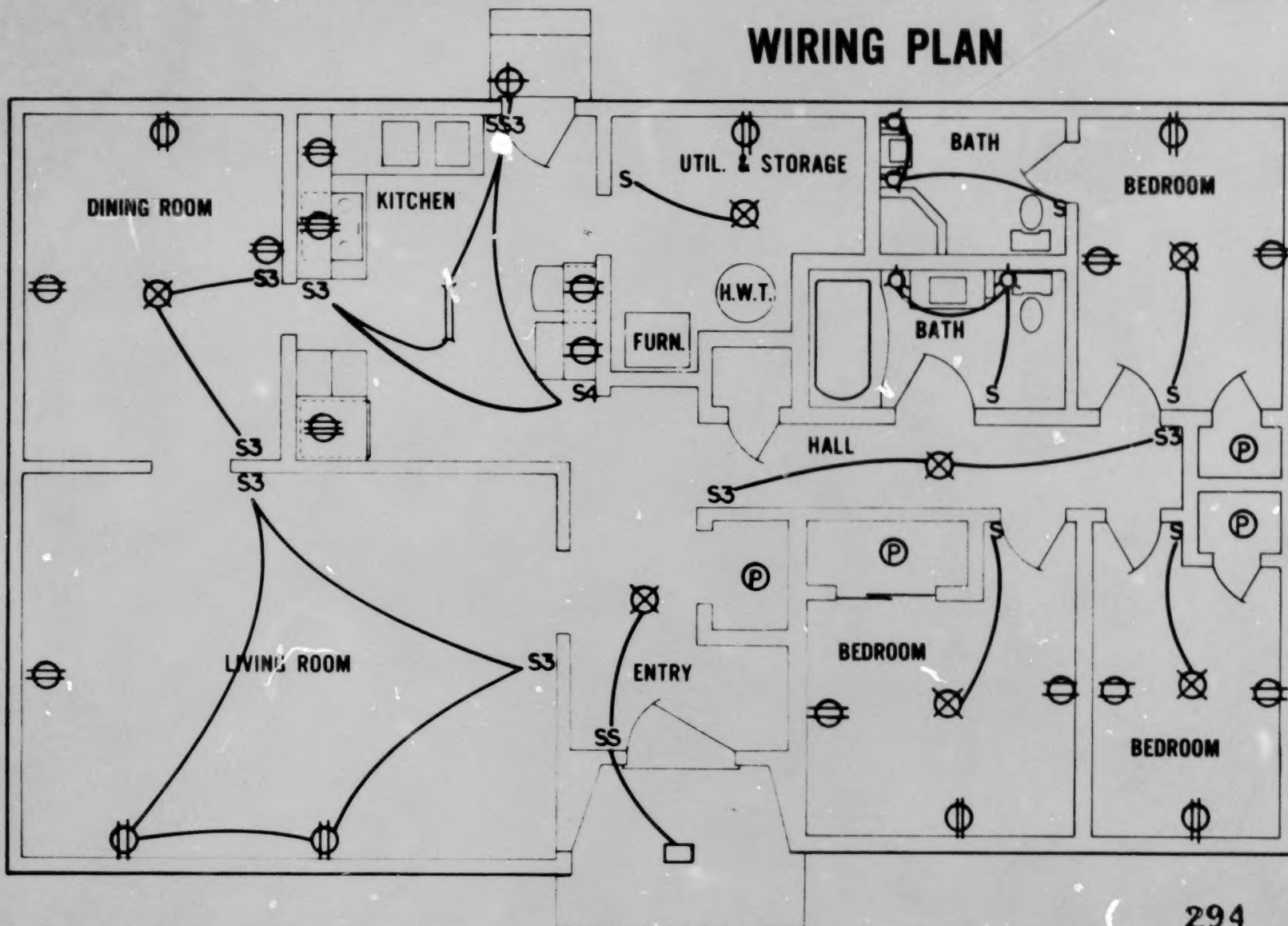
A. Signs of poor wiring

1. Blown fuse
2. Tripped circuit breaker
3. Flickering or dim lights
4. Poorly-operating appliances

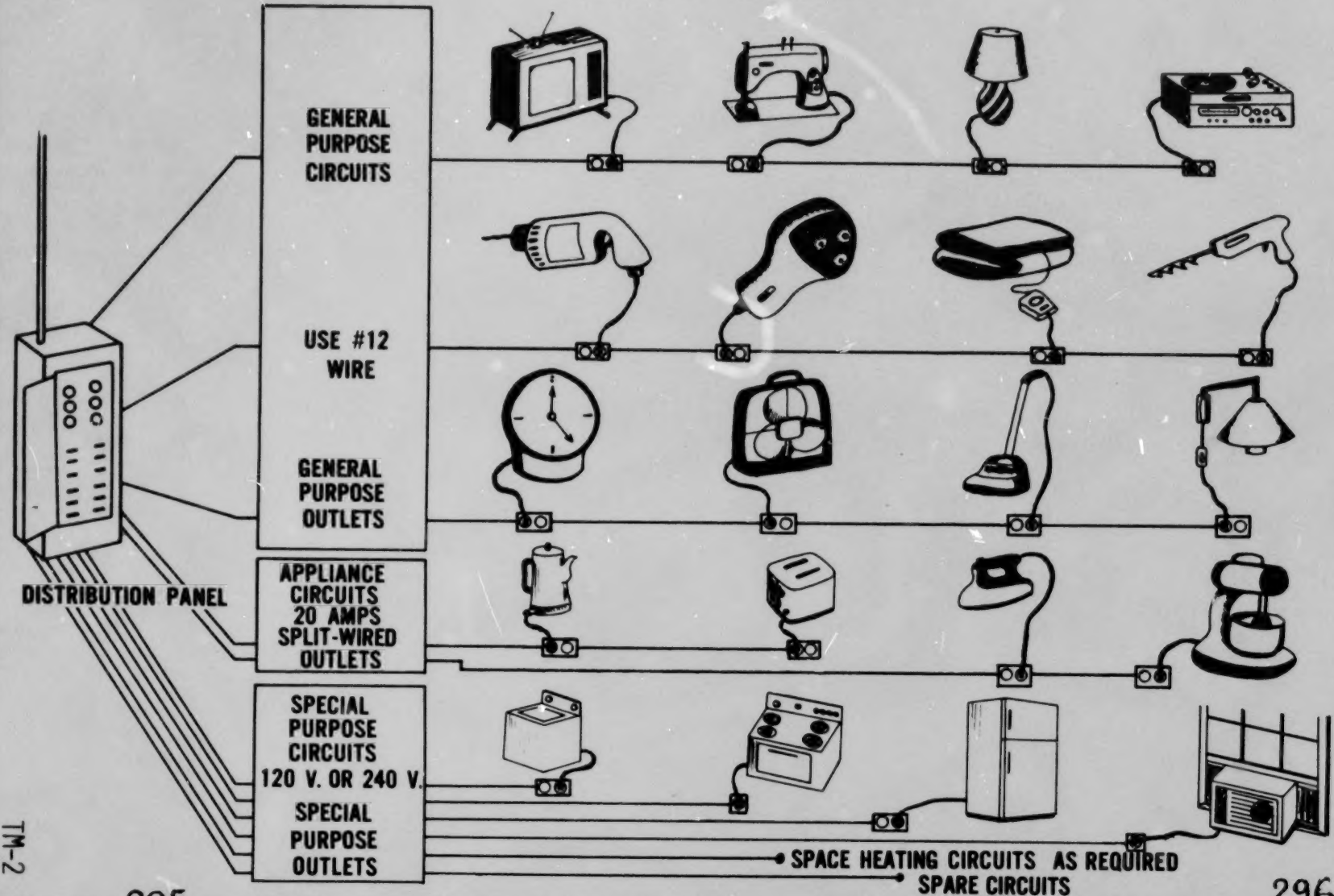
B. Reasons for wiring failure

1. Overloaded circuits
2. Breaker or fuse too small
3. Shorted circuit
4. Loose or broken wires
5. Faulty equipment

WIRING PLAN



BRANCH CIRCUIT



UNIT IV
ELECTRICAL WIRING PROCEDURES

JOB SHEET #1--MOUNT ELECTRICAL BOXES

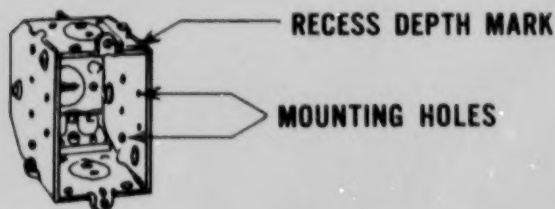
I. Tools and materials needed:

- A. Outlet box
- B. Junction box
- C. Claw hammer
- D. 16 d box nails

II. Procedure:

- A. Locate desired position of outlet box
- B. Locate box mounting holes and recess depth mark on box

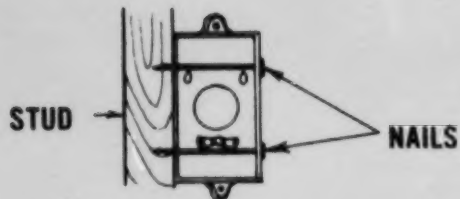
(Note: Recess depth mark is a slight indentation approximately 1/4 inch from box opening.)



- C. Determine which nail holes should be used
- D. Hold box in desired position with recess depth mark even with edge of stud
- E. Drive nails through holes into stud until nails are snug against the box
- F. Check box to be sure it is held tightly in place

G. Repeat steps A through F for mounting junction box

Example:



H. Have instructor check your work

I. Clean work area

J. Store tools properly

UNIT IV

ELECTRICAL WIRING PROCEDURES

JOB SHEET #2--INSTALL NM CABLE IN ELECTRICAL BOXES

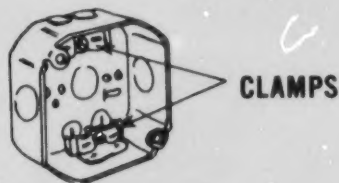
I. Tools and materials needed:

- A. Lineman pliers
- B. Conventional screwdriver
- C. 12/2 NM cable with ground wires
- D. 2 NM cable connectors
- E. Brace and 3/4-inch bit

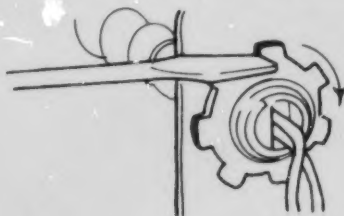
II. Procedure:

- A. Use mounted boxes from Job Sheet #1
- B. Remove knockout from electrical boxes
- C. Remove locknut from connectors

(Note: Boxes may have clamps for holding cable inside and connectors may not be necessary.)

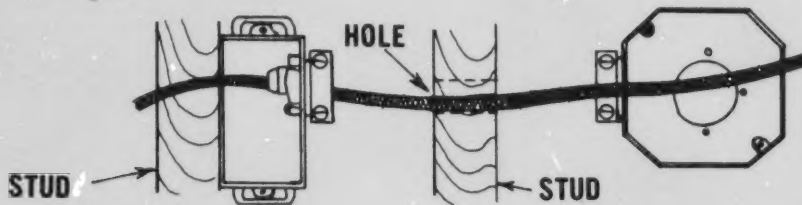


- D. Insert connector in knowckout hole
- E. Screw locknut on connector
- F. Tighten locknut with screwdriver



- G. Drill holes through studs for cable run between boxes
- H. Slide cable through connectors and holes to connect boxes
- I. Have a minimum of 7 inches extending from each box
- J. Cut the cable to length
- K. Tighten screws on connectors

Example:



- L. Have instructor check your work
- M. Clean work area
- N. Store tools properly

UNIT IV
ELECTRICAL WIRING PROCEDURES

JOB SHEET #3--INSTALL DUPLEX RECEPTACLE

I. Tools and materials needed:

- A. Wire stripper
- B. Utility knife
- C. Conventional screwdriver
- D. Long nose pliers
- E. Duplex receptacle

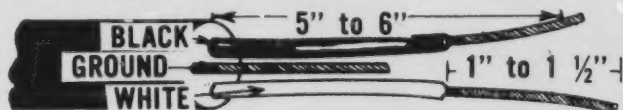
II. Procedures:

- A. Remove about 6 inches of outside insulation from the end of the cable with the utility knife

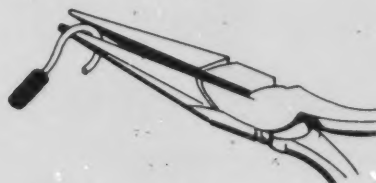
(Caution: Do not cut the insulation on the wires under the outside insulation.)

- B. Remove 1 to 1 1/2 inches of insulation from the two conductors using the wire stripper

(Note: Be sure to use the proper gauge hole on the stripper.)



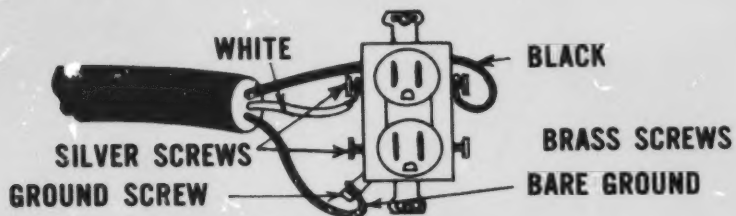
- C. Make a loop on the end of each wire using the long nose pliers



- D. Using the screwdriver, attach the wires to the receptacle as shown below

(Note: Be sure the wire loop is on the screw in the clockwise position.)

Example:



- E. Mount receptacle in outlet box
F. Tighten mounting screws
G. Have instructor check your work
H. Clean work area
I. Store tools properly

UNIT IV
ELECTRICAL WIRING PROCEDURES

JOB SHEET #4--INSTALL SINGLE-POLE SWITCH

I. Tools and materials needed:

- A. Wire stripper
- B. Utility knife
- C. Conventional screwdriver
- D. Single-pole switch
- E. Long nose or chair nose pliers

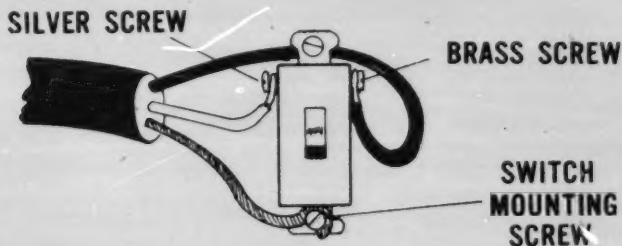
II. Procedures:

- A. Use cable at junction box end of Job Sheet #2
- B. Remove about 6 inches of outer insulation from the end of the cable using utility knife

(Note: Do not cut the insulation on the wires under the outside insulation.)
- C. Remove 1 to 1 1/2 inches of insulation from the 2 conductors using the wire stripper

(Note: Be sure to use the proper gauge hole on the stripper.)
- D. Make a loop on the end of each wire using the long nose or chair nose pliers
- E. Attach wires to the switch as shown below

Example:



- F. Connect ground wire behind switch mounting screw
- G. Have instructor check your work
- H. Clean work area
- I. Store tools properly

UNIT IV
ELECTRICAL WIRING PROCEDURES

JOB SHEET #5--INSTALL 3-WAY SWITCH

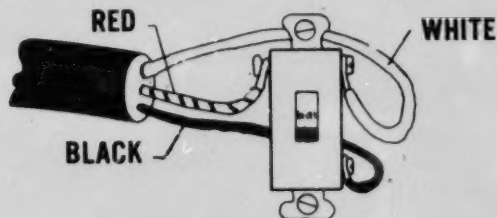
I. Tools and materials needed:

- A. Utility knife
- B. Wire stripper
- C. Conventional screwdriver
- D. 3-way switch
- E. 3 wire NM cable
- F. Chair nose or long nose pliers

II. Procedure:

- A. Strip 6 inches of outer insulation off cable with utility knife
- B. Strip 1 1/2 inches off end of each wire
- C. Make loop on end of each wire
- D. Connect wires to switch as shown below

Example:



- E. Have instructor check work
- F. Clean work area
- G. Store tools properly

UNIT IV
ELECTRICAL WIRING PROCEDURES

UNIT TEST

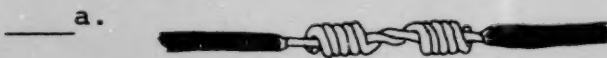
1. Match the terms in the right hand column to the correct definitions on the left by placing the number in the blank

- | | |
|--|------------------------|
| ___ a. All the outlets and receptacles connected on one leg | 1. Outlet box |
| ___ b. A single conductor | 2. Junction box |
| ___ c. Usually bare or green wire that connects circuit to earth for safety | 3. Hot wire |
| ___ d. Several small wires put together in an insulating cover and usually very flexible | 4. Wire size |
| ___ e. Usually black but can be any color except green and always has voltage applied | 5. Cord |
| ___ f. Usually a white wire and serves as a return for current | 6. Electrical cable |
| ___ g. Measure of wire diameter and called the "gauge" of wire | 7. Wire |
| ___ h. A covered outlet box used to enclose splices within a circuit | 8. Ground wire |
| ___ i. A drawing of the house floor plan showing wiring | 9. Neutral wire |
| ___ j. A connection between the wires and electrical devices usually fastened with a screw or clip | 10. Terminal |
| | 11. 3-way switch |
| | 12. Wiring plan |
| | 13. Branch circuit |
| | 14. Duplex receptacle |
| | 15. Single pole switch |

2. Identify the proper order of the three steps in wiring procedure by placing a "1" in the blank by step one, a "2" beside step two and "3" beside step three

- ___ a. Determine legs or branch circuits
- ___ b. Install wires and devices according to wiring plan
- ___ c. Draw wiring plan

3. Identify the splices and connections below by placing the letter of each description in the blank beside its drawing

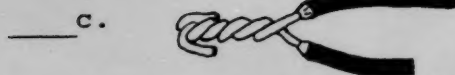


1. Wire nut



2. Solderless terminal

3. Pigtail splice

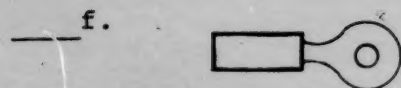


4. Tap splice

5. Terminal loop



6. Two-wire splice



4. Identify the signs and reasons for wiring failure by placing a "✓" in the blank beside the correct term.

- ☐ a. Blown fuse
- ☐ b. Tripped circuit breaker
- ☐ c. Burned out bulbs
- ☐ d. Flickering and dim lights
- ☐ e. Poorly operating appliances
- ☐ f. Overload circuits
- ☐ g. Shorted circuits
- ☐ h. Broken or loose wires
- ☐ i. Faulty equipment

5. Demonstrate the ability to:

- a. Mount electrical boxes
- b. Install NM cable in electrical boxes
- c. Install duplex receptacles
- d. Install single-pole switch
- e. Install 3-way switch

(Note: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT IV
ELECTRICAL WIRING PROCEDURES

ANSWERS TO UNIT TEST

1.

<u>13</u>	a.
<u>7</u>	b.
<u>8</u>	c.
<u>5</u>	d.
<u>3</u>	e.
<u>9</u>	f.
<u>4</u>	g.
<u>2</u>	h.
<u>12</u>	i.
<u>10</u>	j.
2.

<u>2</u>	a.
<u>3</u>	b.
<u>1</u>	c.
3.

<u>6</u>	a.
<u>4</u>	b.
<u>3</u>	c.
<u>1</u>	d.
<u>5</u>	e.
<u>2</u>	f.
4.

<u>✓</u>	a.
<u>✓</u>	b.
<u>✓</u>	c.
<u>✓</u>	d.
<u>✓</u>	e.
<u>✓</u>	f.
<u>✓</u>	g.
<u>✓</u>	h.
<u>✓</u>	i.
5. Evaluated to the satisfaction of the instructor

UNIT V

PLANNING A WIRING LAYOUT

UNIT OBJECTIVE

After completing this unit, the student will be able to draw a wiring plan, using correct electrical symbols, and will identify cable and entrance panel sizes. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match the terms and definitions associated with planning a wiring layout
2. Identify electrical symbols used in a wiring plan
3. Identify the size of electrical cables
4. Identify correct planning of outlets and switches
5. List three types of branch circuits
6. Figure the number of branch circuits needed
7. Select the proper entrance panel size
8. Determine the service entrance cable size
9. Demonstrate the ability to:
 - a. Figure general purpose branch circuits needed
 - b. Determine entrance panel size required
 - c. Draw a wiring plan

UNIT V
PLANNING A WIRING LAYOUT

SUGGESTED ACTIVITIES

- I. Instructor
 - A. Discuss unit objective
 - B. Provide students with information and assignment sheets
 - C. Prepare transparencies and lesson plans
 - D. Discuss information and assignment sheets
 - E. Prepare samples of cable sizes
 - F. Plan a field trip to a job site
 - G. Give test
 - H. Review problem areas identified by test
- II. Student
 - A. Discuss questions on unit objective
 - B. Read and discuss information and assignment sheets
 - C. Complete assignment sheets
 - D. Take unit test
 - E. Discuss test questions missed

INSTRUCTIONAL MATERIALS

- I. Included in this unit
 - A. Objective sheet
 - B. Information sheet
 - C. Transparency masters
 - 1. TM-1--Planning Outlets and Switches
 - 2. TM-2--Never Locate Outlets Near Tub or Shower

3. TM-3--Selecting Entrance Panel Size

D. Assignment sheets

1. Assignment Sheet #1--Figure General Purpose Branch Circuits Needed
2. Assignment Sheet #2--Determine Entrance Panel Size
3. Assignment Sheet #3--Draw a Wiring Plan

E. Unit test

F. Answers to unit test

II. References:

- A. Mix, Floyd. House Wiring Simplified. South Holland, Illinois: Goodheart-Wilcox Co., Inc., 1973.
- B. General Construction Trades. Stillwater, Oklahoma: State Department of Vocational and Technical Education, 1971.

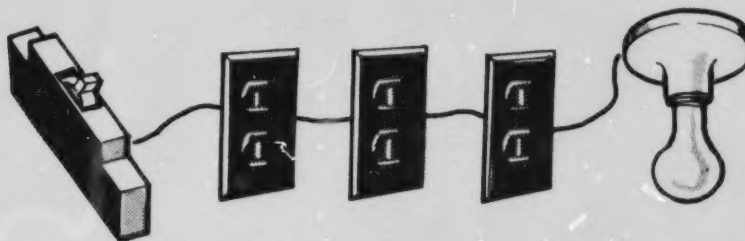
UNIT V

PLANNING A WIRING LAYOUT

INFORMATION SHEET

I. Terms and definitions

- A. Branch circuit--All the outlets and receptacles connected on one breaker



- B. Breaker--A safety switch that connects the branch circuit to the power source
- C. Special purposes outlet--Any outlet for appliances that use 240 volts or motors larger than 1/3 horsepower
- D. Wiring plan--A drawing of the house floor plan showing switch wiring and outlets

II. Symbols used in wiring plans

- | | |
|---------------------------------|--|
| A. Duplex receptacle outlet - | |
| B. Special purpose outlet - | |
| C. 240-volt outlet - | |
| D. Ceiling light outlet - | |
| E. TV outlet - | |
| F. Weatherproof duplex outlet - | |
| G. Single pole switch - | |
| H. Three-way switch - | |
| I. Switch wiring - | |

III. Selecting wire size

- A. Electrical wire varies from No. 40 to No. 4/0 or 0000.

(Note: The larger the gauge number the smaller the wire diameter.)

- B. Reading wire sizes

1. First number is the gauge (size) of the wire
2. Second number shows how many conductors are in the wire

Example: 12/3 = 12 gauge, 3 conductors

- C. Amp rating for wires

<u>Wire Size (Gauge)</u>	<u>Amp Rating</u>
14	14
12	20
10	30
8	40
6	50
4	70
2	95
1	110
1/0 or 0	215
2/0 or 00	145
4/0 or 0000	195

IV. Planning outlets and switches (Transparency #1)

- A. Living room, bedroom, den or dining room

1. One or more ceiling lights controlled by a wall switch
2. Duplex outlets on walls, to be no more than 6 feet apart

- B. Kitchen

1. One or more ceiling lights controlled by wall switch
2. One light over sink, with wall switch
3. Special purpose outlet for dishwasher, disposal, and refrigerator

4. Special purpose outlet for electric range
5. Duplex outlets spaced every 4 feet in work area and 12 feet apart in remainder of kitchen

C. Laundry and utility room

1. One or more ceiling lights controlled by wall switch
2. Grounded duplex outlets
3. Special purpose outlets for dryer, water heater, electric furnace, or air conditioner

D. Bathroom (Transparency #2)

1. One or more lighting outlets located near mirror, with wall switch
2. Duplex receptacles near mirror

(Caution: Never locate duplex receptacles or switches where they can be reached from tub or shower.)

E. Halls

1. One ceiling light controlled by 3-way wall switch
2. One duplex outlet every 12 feet

F. Stairways and closets

1. One light for each landing, controlled by 3-way switch
2. One ceiling light for each closet

G. Exterior entrances

1. At least one light for each entrance, controlled by inside switch
2. One duplex weatherproof receptacle at front and back entrances

H. Garage

1. At least one ceiling light, controlled by 3-way switch

2. At least 2 duplex outlets on rear and side walls
3. One duplex outlet in ceiling for door closer

V. Types of branch circuits

- A. General purpose--20 amp
- B. Small appliance--20 amp
- C. Special purpose individual outlet--50 amp

VI. Figure branch circuits needed

A. General purpose 20 amp branch circuits

1. One branch circuit for each 500 square feet of floor space
2. Nine outlets per general purpose circuit
3. Add total number of outlets, divide by 9, counting any fraction as a whole

Example:

A house has 30 general purpose outlets. To find number of general purpose branch circuits needed:

$$30 \div 9 = 3.3, \text{ or } 4 \text{ circuits needed}$$

(Note: Do not count small outlets on small appliance circuits.)

B. Small appliance branch circuits

1. Three circuits per house
2. Three outlets for each circuit
3. Used in kitchen, laundry room, and dining room

C. Special purpose individual circuits

1. One circuit for each outlet
2. 240 volt outlets
3. 1/3 horsepower or larger

VII. Selecting entrance panel size (Transparency #3)

A. Standard size panels

1. 100 amp

(Note: 100 amp is minimum size allowed.)

2. 125 amp

3. 150 amp

4. 200 amp

B. Determine size needed by adding all wattage, dividing by volts of service equals amps

Example: Total wattage of all circuits = 20,000
watts

House has 240 volt service

$$20,000 \div 240V = 83.3 \text{ amps}$$

House needs 100 amp panel

C. Each branch circuit requires a breaker switch in panel

D. Each 240V circuit requires two breaker switches

E. Leave a minimum of 4 open circuits for future needs

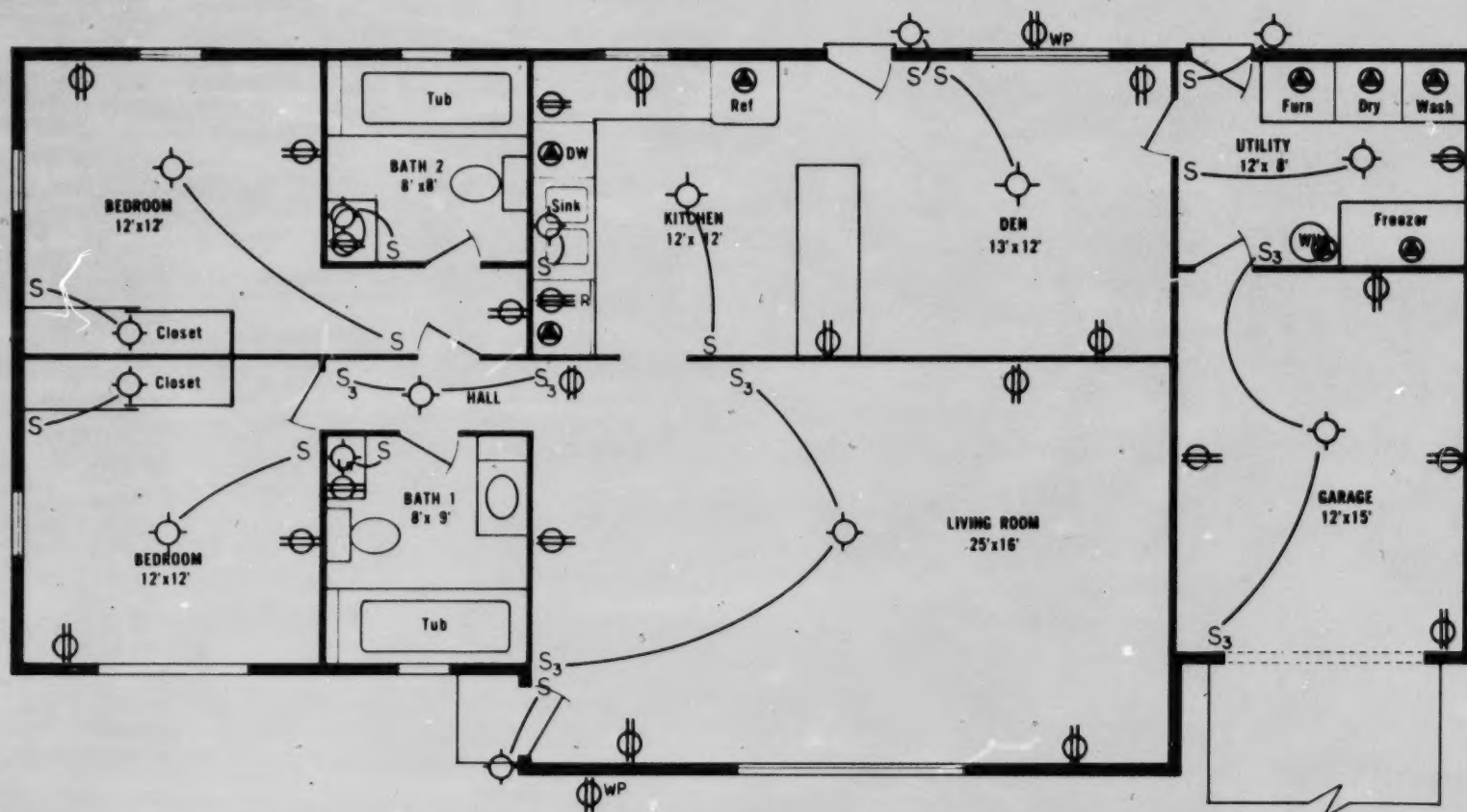
VIII. Determine service entrance cable size

- A. 100 amp panel-use 1/0

- B. 150 amp panel-use 2/0

- C. 200 amp panel-use 4/0

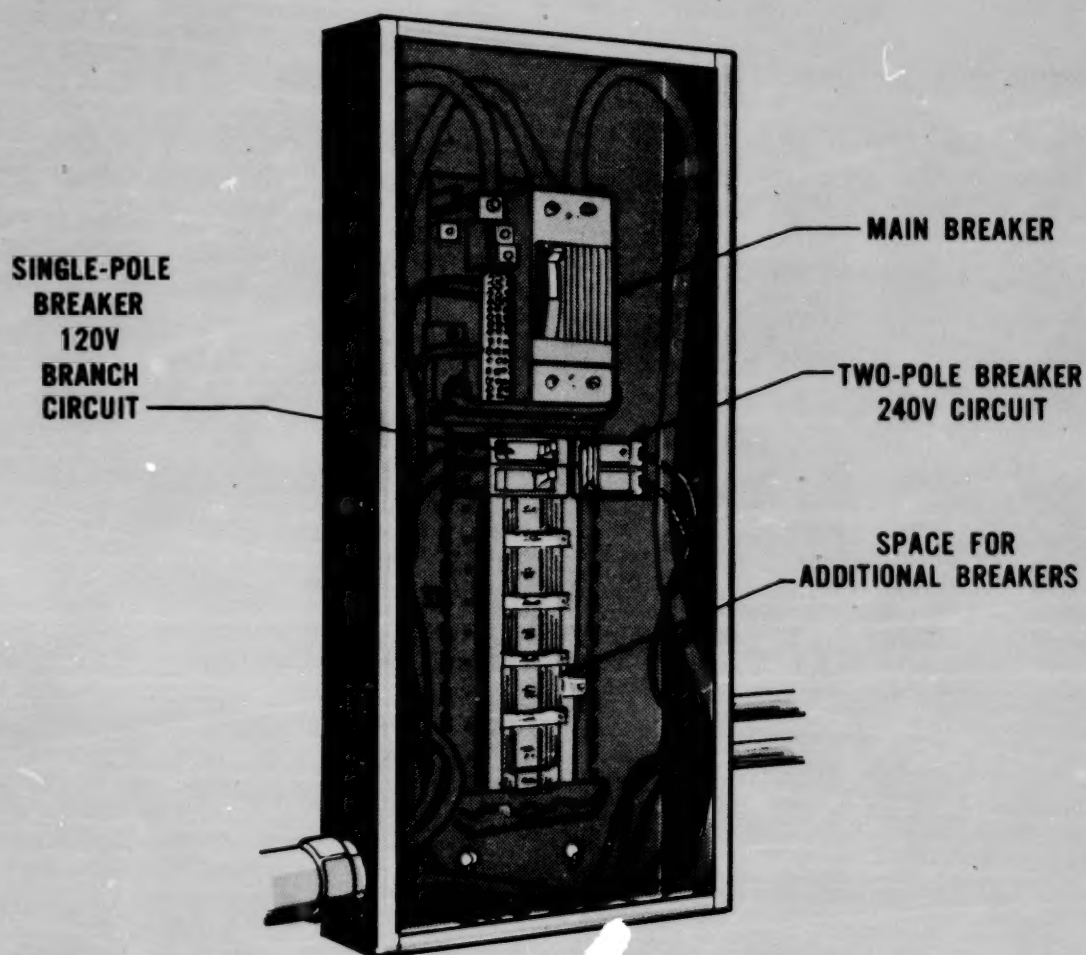
PLANNING OUTLETS AND SWITCHES



NEVER LOCATE OUTLETS NEAR TUB OR SHOWER



SELECTING ENTRANCE PANEL SIZE



SERVICE ENTRANCE, 200-AMPERE CAPACITY

UNIT V

PLANNING A WIRING LAYOUT

ASSIGNMENT SHEET #1--FIGURE GENERAL PURPOSE BRANCH
CIRCUITS NEEDED

Directions: Using the information given, figure the number of general purpose circuits the house will need

House has 42 general purpose outlets

No more than 9 outlets per circuit

1. _____ number of outlets
2. $\div$ _____ number of outlets allowed per circuit
3. $=$ _____ number of circuits

(Remember: Any fraction of a number counts as one circuit.)

So 4.6 circuits

4. $=$ _____ actual number of general purpose circuits

UNIT V

PLANNING A WIRING LAYOUT

ASSIGNMENT SHEET #2--DETERMINE ENTRANCE PANEL SIZE

Directions: Using the information below, determine what size entrance panel is needed for each problem

1. 16,000 watts is total wattage of all circuits
120 volt service to house

- a. _____ total watts of circuits
b. $\div$ _____ service voltage
c. = _____ amps
d. so: _____ amp panel is the size needed

(Note: Panel should have a higher amp rating than total amps used.)

2. 40,000 watts is total wattage of all circuits
240 volt service to house

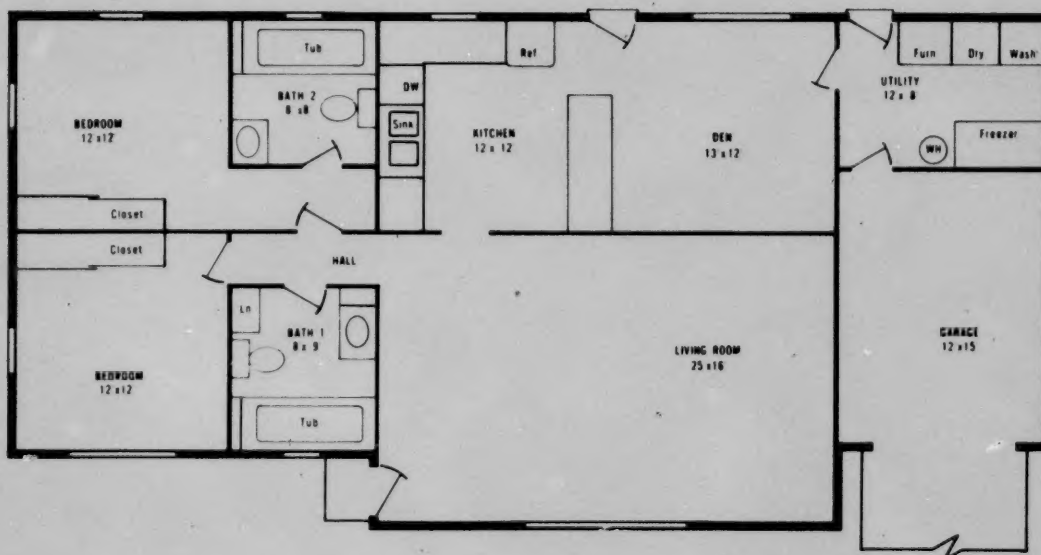
- a. _____ total watts of circuits
b. $\div$ _____ service voltage
c. = _____ amps
d. so: _____ amp panel is needed

UNIT V

PLANNING A WIRING LAYOUT

ASSIGNMENT SHEET #3--DRAW A WIRING PLAN

Directions: Draw a wiring plan on the floor plan below. Put in all outlets, lights, switches, and special purpose outlets. Use the information sheet to help determine how many outlets, what type switches, and other help you may need.



UNIT V
PLANNING A WIRING LAYOUT

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. 42 number of outlets
2. 9 number of outlets allowed per circuit
3. 4.6 number of circuits
4. 5 actual number of general purpose circuits

Assignment Sheet #2

1. a. 26,000 total wattage of circuits
b. 120V service voltage
c. 133.3 amps
d. 150 amp panel needed
2. a. 40,000 total wattage of circuits
b. 240V service voltage
c. 166.6 amps
d. 200 amp panel needed

Assignment Sheet #3

Evaluated to the satisfaction of the instructor

UNIT V

PLANNING A WIRING LAYOUT

UNIT TEST

1. Match the electrical terms on the right to the correct definition on the left by placing the number of the blank

- | | |
|--|----------------------------|
| ___ a. A safety switch that connects the branch circuit to the power source | 1. Branch circuit |
| ___ b. All the outlets and receptacles connected on one breaker | 2. Conduit |
| ___ c. Any outlet for appliances that use 240 volts or motors larger than 1/3 horsepower | 3. Wiring plan |
| ___ d. A drawing of the house floor plan showing switch wiring and outlets | 4. Adapter |
| | 5. Breaker |
| | 6. Special purpose outlets |

2. Identify the electrical symbols on the right by placing the number beside each in the blank on the left

- | | |
|-----------------------------------|--|
| ___ a. Switch wiring | 1.  |
| ___ b. 3-way switch | 2.  |
| ___ c. Single-pole switch | 3.  |
| ___ d. Weatherproof duplex outlet | 4.  |
| ___ e. Ceiling light outlet | 5.  |
| ___ f. 240-volt outlet | 6. S |
| ___ g. Special purpose outlet | 7. S ₃ |
| ___ h. Duplex receptacle outlet | 8. S  |

3. Identify the size of the cables below by writing the two numbers in the blank that describe each wire

Example: 18/3 g. 18 gauge, 3 conductors

- ___ a. 14 gauge, 2 conductors
- ___ b. 10 gauge, 3 conductors
- ___ c. 12 gauge, 3 conductors
- ___ d. 16 gauge, 2 conductors w/ground
4. Identify the correct planning of outlets and switches by placing an "✓" in the blank beside correct statements only
- ___ a. At least one ceiling light in livingroom or bedroom
- ___ b. Duplex outlets every 4 feet in work area of kitchen
- ___ c. Put outlets near tub in bathroom
- ___ d. Range in kitchen should be a special purpose outlet
5. List the three types of branch circuits
- a.
- b.
- c.
6. Figure the number of branch circuits needed with the information below

A house has 32 general purpose outlets

- ___ a. number of outlets
- 9 number of outlets per circuit
- = ___ b. number of circuits

So: ___ c. is actual number of branch circuits

7. Select the proper entrance panel size for each of the amps below. Choose one of the four standard sizes of 100, 125, 150, or 200 amp panel

- ☐ a. 85 amps used by house
- ☐ b. 134 amps used by house
- ☐ c. 169 amps used by house
- ☐ d. 101 amps used by house

8. Determine the service entrance cable size for each of the panels below

- ☐ a. 100 amp panel
- ☐ b. 150 amp panel
- ☐ c. 200 amp panel

9. Demonstrate the ability to:

- a. Figure general purpose branch circuits needed
- b. Determine entrance panel size
- c. Draw a wiring plan

(Note: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT V
PLANNING A WIRING LAYOUT

ANSWERS TO UNIT TEST

1. $\frac{5}{1}$ a.
 $\frac{6}{3}$ b.
 $\frac{7}{3}$ c.
 $\frac{8}{3}$ d.
2. $\frac{8}{7}$ a.
 $\frac{9}{4}$ b.
 $\frac{10}{3}$ c.
 $\frac{11}{2}$ d.
 $\frac{12}{5}$ e.
 $\frac{13}{6}$ f.
 $\frac{14}{1}$ g.
 $\frac{15}{1}$ h.
3. $\frac{14}{10}$ 2a.
 $\frac{10}{12}$ 3b.
 $\frac{12}{16}$ 3c.
 $\frac{16}{2}$ d.
4. $\frac{1}{1}$ a.
 $\frac{2}{1}$ b.
 $\frac{3}{1}$ c.
 $\frac{4}{1}$ d.
5. a. General purpose
b. Small appliance
c. Special purpose
(Note: In any order)
6. $\frac{2}{3.5}$ a.
 $\frac{3.5}{4}$ b.
 $\frac{4}{4}$ c.
7. $\frac{100}{150}$ a.
 $\frac{150}{200}$ b.
 $\frac{200}{125}$ c.
 $\frac{125}{125}$ d.
8. $\frac{1}{2}$ 0 a.
 $\frac{2}{4}$ 0 b.
 $\frac{4}{4}$ 0 c.
9. (a-c.) Evaluated to the satisfaction of the instructor

UNIT I
PAINTING SAFETY

UNIT OBJECTIVE

After completing this unit, the student will be able to use safe procedures when painting and preparing to paint. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with painting safety.
2. Identify the hazards of solvents and paints.
3. Identify safety procedures in using ladders.
4. Identify safety procedures in using scaffolds.
5. Prepare a painting safety poster.
6. Demonstrate the ability to:
 - a. Set up ladders.
 - b. Set up freestanding scaffolds.

UNIT I
PAINTING SAFETY

SUGGESTED ACTIVITIES

- I. Instructor:
 - A. Discuss unit objectives.
 - B. Provide students with information, assignment, and job sheets.
 - C. Prepare transparencies.
 - D. Plan a field trip to painting job site or paint factory.
 - E. Give test.
 - F. Review problem areas identified by test.
- II. Student:
 - A. Discuss questions of unit objectives.
 - B. Read and discuss information, assignment and job sheets.
 - C. Complete assignment and job sheets.
 - D. Take test.
 - E. Discuss questions missed on test.

INSTRUCTIONAL MATERIALS

- I. Included in this unit:
 - A. Objective sheet
 - B. Information sheet
 - C. Transparency masters
 - 1. I-TM-1--Types of Ladders
 - 2. I-TM-2--Types of Scaffolds
 - 3. I-TM-3--Freestanding Scaffold Assembly

- D. Assignment Sheet--Prepare a Painting Safety Poster
- E. Job Sheets
 - 1. Job Sheet #1--Set-Up Ladders
 - 2. Job Sheet #2--Set-Up Scaffolds
- F. Unit test
- G. Answers to unit test

II. References:

- A. Finishing, Construction Industry Series, Washington, D.C.: U. S. Office of Education, U. S. Government Printing Office. Stock No. 017-080-014190.
- B. General Construction Trades. Stillwater, Oklahoma: State Department of Vocational and Technical Education. 1971.
- C. Painting and Decorating Encyclopedia, Homewood, Illinois: The Goodheart-Willcox Co. Inc. 1964.

UNIT I
PAINTING SAFETY

INFORMATION SHEET

I. Terms and definitions

- A. Solvent--Highly flammable chemicals used to thin paints and clean equipment

Examples: denatured alcohol, turpentine, naptha, benzine, benzol, and tuluol

- B. Toxic--Poisonous

- C. Lacquer--Highly flammable, toxic, stains and varnishes

- D. Vapor--A gas given off by a flammable liquid

- E. OSHA--Occupational Safety and Health Act

- F. Rung--A step on a ladder

- G. Blocking--Blocks of wood used to support scaffold legs on the ground

II. Solvents and paints

- A. Do not use or store near heat or open flame

(CAUTION: Solvent vapors are heavier than air and can travel long distances close to the floor.)

- B. Use only in well-ventilated areas

- C. Avoid working with solvents in large open containers

- D. Avoid spilling

(NOTE: If solvent is spilled on clothing, change into clean, dry clothes immediately.)

- E. Do not keep solvent-soaked rags in your pockets

- F. Wash hands after working with solvents or paint

(NOTE: Some paints contain lead which is harmful to health if it gets into the body.)

- G. Wear proper protective clothing

H. When using, if you begin to feel sick, drowsy or dizzy, stop work and get fresh air

I. Keep out of reach of children

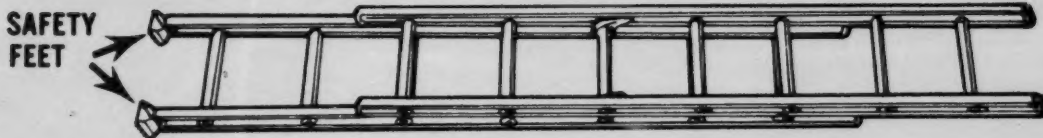
III. Ladders (Transparency #1)

A. Store wooden ladder in dry area

B. Should be kept off the ground when stored by setting on blocks or hung straight on the wall

C. Check for cracking or splintering before using

D. Extension ladders should have safety feet to prevent skidding



E. Never use a metal ladder near electrical wires

F. Do not paint wooden ladders

G. Ladders should stand solidly on the ground when in use

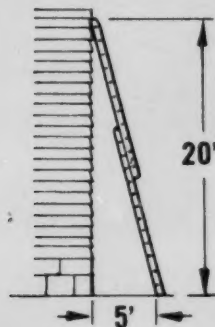
H. Never overextend your reach when standing on a ladder

I. Never stand on top rung

J. Two persons should set up heavy ladders

K. Stepladders should have all four legs on solid, level ground

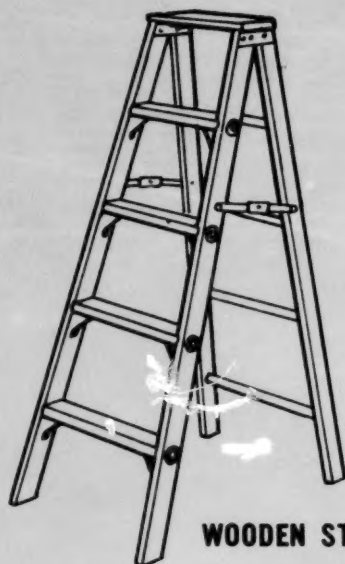
L. Extension ladders should stand with base one-fourth distance of height away from wall



IV. Scaffolds (Transparency #2)

- A. Always set on solid, level ground
- B. Check scaffold framing for proper connections after assembly
- C. Should be strong enough to support the load
- D. Anchor properly
- E. Use guardrail to prevent fall
- F. Check OSHA and local safety regulations

TYPES OF LADDERS



WOODEN STEP



ALUMINUM EXTENSION

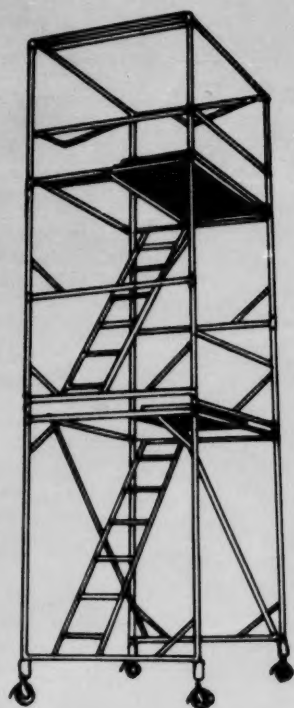


WOODEN STEP



ALUMINUM STEP

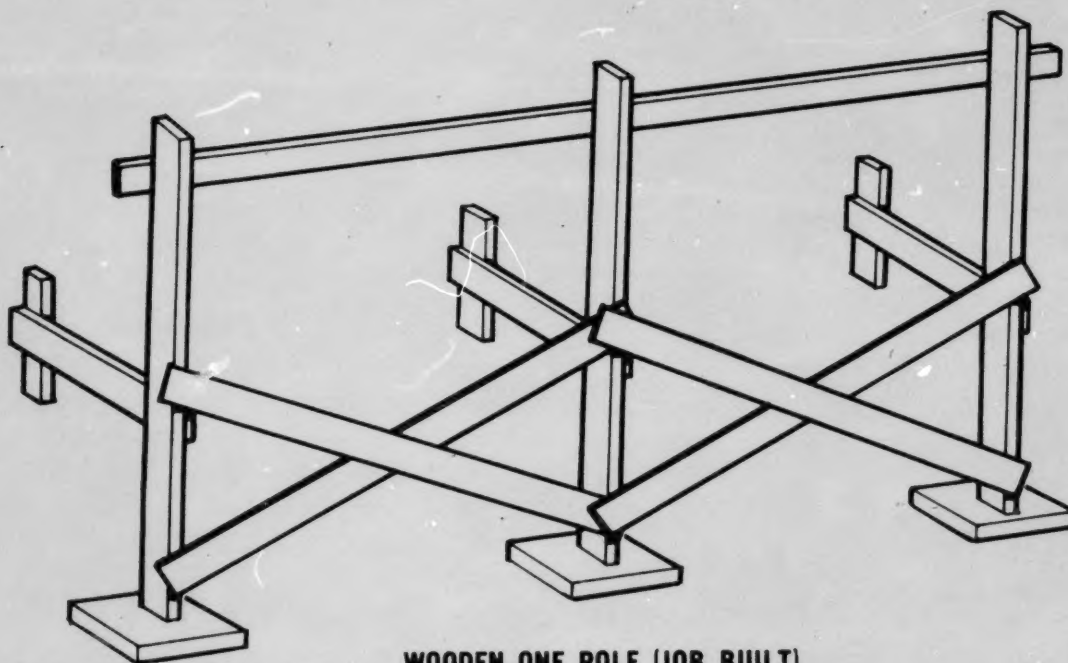
TYPES OF SCAFFOLDS



**FREESTANDING METAL
STAIRWAY**

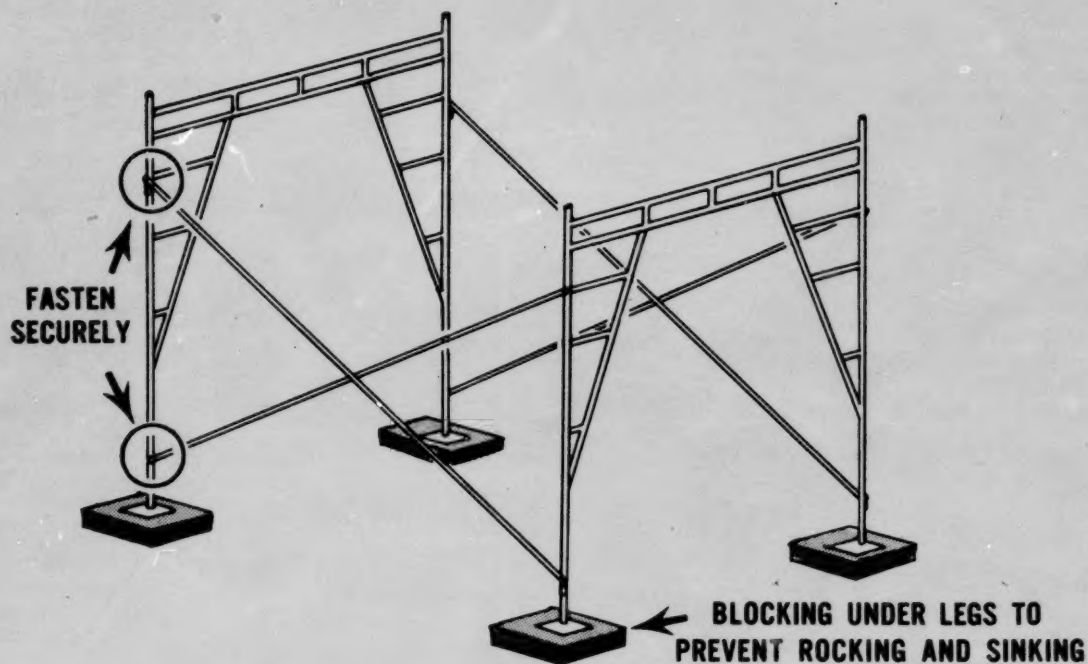


**FREESTANDING METAL
SHORT SPAN**



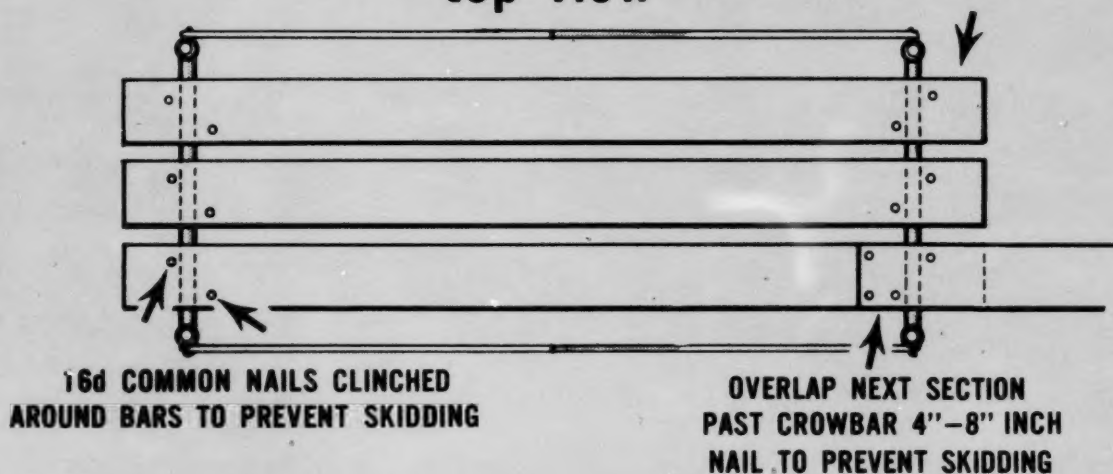
WOODEN ONE POLE (JOB BUILT)

FREESTANDING SCAFFOLD ASSEMBLY



top view

MINIMUM 4" OVERLAP
MAXIMUM 8" OVERLAP



UNIT I

PAINTING SAFETY

ASSIGNMENT SHEET--PREPARE PAINTING SAFETY POSTER

Directions: On a piece of poster board or sheet of typing paper, prepare a poster about painting safety. You may want to use some of the safety rules covered in the Information Sheet for ideas in making your poster.

(NOTE: The instructor may want to display your poster as a safety reminder.)

UNIT I
PAINTING SAFETY

JOB SHEET #1--SET-UP LADDERS

- I. Tools and materials
 - A. Extension ladder
 - B. Stepladder
- II. Procedure
 - A. Extension ladder set up
 - 1. Remove all loose objects from area ladder is to be set up
 - 2. Place base of ladder against base of wall
 - 3. Raise ladder from top end and place against top of wall
 - 4. Move base of ladder out from base of wall one-fourth the height of the ladder
 - 5. Be sure base of ladder is standing level and solid
 - B. Stepladder
 - 1. Unfold and place all four legs of ladder on flat surface
 - 2. If ground is unlevel, use solid blocking under as many legs as necessary to make level
 - 3. Be sure braces of ladder are locked into position before climbing on ladder

UNIT I
PAINTING SAFETY

JOB SHEET #2--SET-UP FREESTANDING SCAFFOLD

- I. Tools and materials
 - A. Freestanding metal scaffolding
 - B. 2" x 12" lumber for walk board
 - C. 16 d nails
 - D. Claw hammer
 - E. Wooden blocks for blocking
- II. Procedure (Transparency #3)
 - A. Clear and level area where scaffold will be placed
 - B. Assemble uprights of scaffold

(NOTE: The type of scaffold and fasteners used will determine how to assemble. Ask your instructor for assistance.)
 - C. Place blocking under legs
 - D. Secure the bracing
 - E. Tie scaffold to wall every two feet
 - F. Place 2" x 12" walk boards with proper overlap

(NOTE: See Transparency #3 for details.)
 - G. Secure walk boards
 - H. Install guard rails
 - I. Store tools properly

UNIT I
PAINTING SAFETY

UNIT TEST

1. Match the terms in the right hand column to the correct definition on the left. Place the number in the blank.

_____ a.	Block of wood used to support scaffold legs on the ground	1. Lacquer
_____ b.	A step on a ladder	2. Solvent
_____ c.	Occupational Safety and Health Act	3. Toxic
_____ d.	A gas given off by a flammable liquid	4. Vapor
_____ e.	Highly flammable, toxic stains and varnishes	5. OSHA
_____ f.	Poisonous	6. Rung
_____ g.	Highly flammable chemicals used to thin paints and clean equipment	7. Blocking

2. Identify the true statements about solvents and paints by placing a "✓" in the blanks.

- _____ a. Solvent vapors are lighter than air.
- _____ b. Solvents and paints should be used in well-ventilated areas.
- _____ c. Do not keep solvent-soaked rags in your pocket.
- _____ d. Work with solvents in large open containers.
- _____ e. If you feel sick or dizzy, stop work and get fresh air.

3. Identify the true statements about ladders by placing a "✓" in the blanks.

- _____ a. Ladders should be kept off the ground and hung straight when stored.

- ☐ b. Check for cracking and splintering before using.
 - ☐ c. Store wooden ladders in cool, damp area.
 - ☐ d. Never use metal ladder near electrical wires.
 - ☐ e. Wooden ladders should be painted to prevent cracks.
 - ☐ f. Extension ladders should stand with the base one-fourth distance of height away from the wall.
 - ☐ g. Be careful when standing on the top rung.
 - ☐ h. Two persons should set up heavy ladders.
4. Identify the true statements about scaffolds. Place a "✓" in the blank.
- ☐ a. Check scaffold framing connections after assembly.
 - ☐ b. Scaffolds should be set on solid level ground.
 - ☐ c. Scaffolds should be strong enough to support the load.
 - ☐ d. Guardrails are used to make the scaffold stronger.
 - ☐ e. OSHA provides safety regulations for scaffolding.
5. Prepare a painting safety poster.
6. Demonstrate the ability to:
- a. Set-up ladders
 - b. Set-up freestanding scaffold.

(NOTE: If activities #5 and #6 have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT I
PAINTING SAFETY

ANSWERS TO UNIT TEST

1. 7 a.
6 b.
5 c.
4 d.
1 e.
3 f.
2 g.
2. a. heavier than air
✓ b.
✓ c.
 d. do not use large, open container
✓ e.
3. ✓ a.
✓ b.
 c. store in dry area
✓ d.
 e. never paint wooden ladders
✓ f.
 g. never stand on top rung
✓ h.

4. ☒ a.

☒ b.

☒ c.

☐ d. used to prevent falls

☒ e.

5. Evaluated to the satisfaction of the instructor

6. (a-c) Evaluated to the satisfaction of the instructor

UNIT II

PAINTING TOOLS AND EQUIPMENT

UNIT OBJECTIVE

After completing this unit, the student will be able to identify painting tools and equipment. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with painting tools and equipment.
2. Identify types of paint brushes.
3. Identify mechanical cleaning equipment used in painting.
4. List three types of hand or power paint mixes.
5. Identify characteristics of paint covers and cloths.
6. List two kinds of mechanical paint sprayers.
7. Identify drywall tools.
8. Identify types of paint rollers.
9. List three miscellaneous tools and materials used by painters.
10. Demonstrate the ability to:
 - a. Identify painting tools and equipment.
 - b. Inspect painting tools and equipment.

UNIT II

PAINTING TOOLS AND EQUIPMENT

SUGGESTED ACTIVITIES

I. Instructor:

- A. Discuss unit objectives
- B. Provide students with information and assignment sheets
- C. Prepare transparencies
- D. Prepare tool and equipment display
- E. Give test
- F. Review problem areas identified by test

II. Student:

- A. Discuss questions of unit objectives
- B. Read and discuss information and assignment sheets
- C. Complete assignment sheets
- D. Take test
- E. Discuss questions missed on test

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
 - 1. II-TM-1--Types of Paint Brushes
 - 2. II-TM-2--Power Cleaning Equipment
 - 3. II-TM-3--Types of Hand Mixers
 - 4. II-TM-4--Types of Power Mixers

5. II-TM-5--Compressed Air Sprayers
6. II-TM-6--Airless Sprayers
7. II-TM-7--Drywall Tools
8. II-TM-8--Types of Rollers and Handles
9. II-TM-9--Types of Roller Pans

D. Assignment Sheets

1. Assignment Sheet #1--Identify Painting Tools and Equipment
2. Assignment Sheet #2--Inspect Painting Tools and Equipment

E. Unit test

F. Answers to unit test

II. References:

- A. Painting and Decorating Encyclopedia, Homewood, Illinois: The Goodheart-Wilcox Co., Inc. 1964.
- B. Feirer, John L. and Hutchings, Gilbert R. Carpentry and Building Construction. Peoria, Illinois: Chas. A. Bennett Co., Inc. 1976.
- C. General Construction Trades. Stillwater, Oklahoma: State Department of Vocational and Technical education. 1971.

UNIT II
PAINTING TOOLS AND EQUIPMENT

INFORMATION SHEET

I. Terms and definitions

- A. Bristle--Animal hair or man-made fibers used to make paint brushes
- B. Sash--Frame around a window
- C. Pigment--substance put in paint that gives it color
- D. Vehicle--Liquid mixed with pigment to make paint
- E. Acoustical--Any material that absorbs sound or noise
- F. Drywall--Interior walls are constructed of dry materials (EXAMPLES: Sheetrock or paneling would be drywall but plaster would not.)
- G. Nap--Surface of paint roller cover
- H. Caustic--Any material that can cause burns by chemical reaction
- I. Remote--Not attached
- J. Bedding--Covering nail holes and drywall joints by smoothing on texture with a joint knife
- K. Floating--Applying more texture to smooth the surface
- L. Synthetic--Man-made

II. Brushes

- A. Kinds of bristle
 - 1. Natural hair--used with enamel, oil base paints, stains and varnishes
 - a. swine hair
 - b. camel's hair

- c. horsehair
 - 2. Fiber--used for caustic paints and texturing
 - a. rice root
 - b. straw
 - 3. Nylon
 - a. man-made from petroleum
 - b. used in all types of paints
- B. Types of brushes (Transparency #1)
- 1. Flat sash and trim
 - a. one to 3 1/2 inches in width
 - b. natural hair or nylon bristle
 - c. used for finish work an small areas
 - 2. Angular sash
 - a. one to 3 1/2 inches in width
 - b. natural hair or nylon bristle
 - c. used for fine line finish work and especially for tight corners
 - 3. Wall
 - a. three and one-half inches or wider
 - b. usually nylon bristles
 - c. used for large, flat areas
 - 4. Stippling
 - a. two inches wide by five inches long or larger
 - b. made with fiber bristle
 - c. used to apply texture to walls and ceiling in decorative patterns

III. Cleaning equipment

A. Hand

1. Scraper--Used to remove cracked, blistered and peeling materials from wall surfaces



2. Wire brush--Steel bristle brush used to remove dirt and loose material from wall surface



B. Power (Transparency #2)

1. Electric sander
 - a. can be belt or disc type
 - b. used to smooth surface before painting
2. Wire wheel brush
 - a. circular brush mounted on electric motor
 - b. used to clean irregular wall surfaces
3. Sandblaster
 - a. uses sand blown by air
 - b. used to clean flat or irregular surface
 - c. also used to clean rust from metal
4. Torch--Used to blister the old paint for easy removal (Caution: Wear eye protection when using cleaning equipment.)

IV. Mixers--Combine pigment and vehicle

A. Hand (Transparency #3)

1. Flat paddle
 - a. one inch to 2 1/2 inches wide
 - b. may be made of wood or metal

- c. some may have holes in flat mixing end

2. Shaker

- a. container is mounted in shaker
- b. handle turns container

3. Agitator--stirring device mounted on top of paint container

B. Power (Transparency #4)

1. Agitator--stirring device mounted on a drill motor

2. Shaker

- a. uses electric motor for power
- b. has timer switch to control length of time shaker motor runs

3. Drum

- a. uses electric motor for power
- b. used to mix accoustical materials

V. Covers and cloths

A. Drop covers

1. Cotton ducking

- a. used to protect floors from paint droppings and spatter

2. Plastic tarp

- a. large plastic sheet
- b. used where waterproof cover is needed

B. Furniture covers

1. Cotton batting

- a. thick cotton pads
- b. used to protect furniture from damage by painting equipment

2. Cotton ducking

- a. thick cotton sheets sewn together
- b. used to cover furniture for protection against paint droppings

- C. Paint Cloths

1. Canvas

- a. made of coarse cotton material
- b. used to rub stain on wood

2. Cheesecloth

- a. a soft cotton material with open weave
- b. used to wipe smooth stain effect onto wood

3. Terry cloth

- a. thick, soft cotton material with looped pile
- b. used to wipe up spills and smears

(Caution: Store used paint cloths in metal air tight container to prevent fires.)

- VI. Types of sprayers

- A. Compressed air (Transparency #5)

1. Uses air compressor, spray gun and paint pot
2. Works on low-pressure air
3. Types of guns
 - a. suction gun
 - b. pressure feed gun
4. Paint pot may be attached to gun or remote
5. Filter/regulator traps any moisture in the air and regulates air pressure

- B. Airless (Transparency #6)

1. May have piston or diaphragm-type pump
2. Types of airless guns
 - a. paint--used for painting
 - b. accoustical--used for spraying texture and accoustical material
3. Paint is forced to nozzle under 1500 to 3500 PSI
(CAUTION: Never put your hand in front of the nozzle. High pressure fluid can cause severe cuts or puncture wounds.)

VII. Drywall tools (Transparency #7)

A. Knives

1. Utility
 - a. has a razor blade cutting edge
 - b. used to cut and trim drywall material
2. Joint
 - a. usually 4 or 5 inches wide
 - b. used to bed tape and holes
3. Corner
 - a. usually 6 inches wide with square corners on blade
 - b. used to bed and float tapes
4. Angle
 - a. usually 3 inches wide
 - b. used for work in tight corners

B. Trowels

1. Joint
 - a. fourteen inches long by four inches wide with a 3/16 inch concave curve in blade
 - b. used to apply finish coats of texture over

taped joints

2. Corner

a. double bladed

b. used to float inside corners

VIII. Rollers, handles and pans (Transparency #8)

A. Types of rollers

1. Flat wall--usually 7 or 9 inches wide

2. Corner--usually made of foam plastic

3. Trim--usually 2 or 4 inches wide

4. Pipe--split rollers on a curved frame

5. Commercial

a. eighteen or 24 inches wide

b. used for very large wall areas

B. Roller cover material

1. Sheepswool--used with most paints

2. Mohair--used with most paints

3. Synthetic--used with latex paint

4. Short nap--produces a smooth finish

5. Long nap--produces a rough finish

C. Roller handles

1. Wood

a. threaded to screw into roller frame

b. made in 48 to 60-inch lengths

2. Extension

a. made of aluminum tube

b. has 2 or 3 extension sections

c. can be 6 to 24 feet in length

D. Roller pans (Transparency #9)

1. Flat pan--used with flat wall, corner, pipe, or trim rollers to paint small areas
2. Commercial pan--used with wide rollers to paint large wall areas
3. Roller screen and 5-gallon bucket--used with all types of rollers to paint large areas

IX. Miscellaneous tools and materials

- A. Caulking gun--used to squeeze putty, sealer, or glue onto surfaces and joints

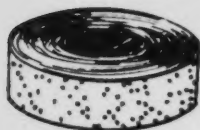


- B. Pails and buckets--used for mixing painting materials and cleaning painting tools

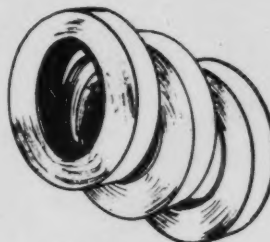


C. Tapes

1. Perforated paper--used to cover dry wall joints that are to be bedded
2. Masking--used to protect areas that are not to be painted



PERFORATED PAPER TAPE



MASKING TAPE

TYPES OF PAINT BRUSHES



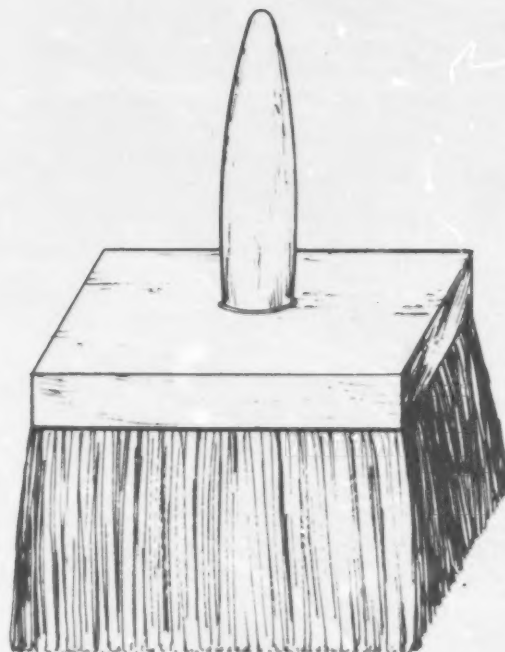
WALL



FLAT SASH AND TRIM

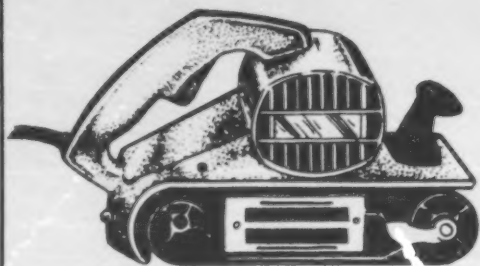


ANGULAR SASH AND TRIM

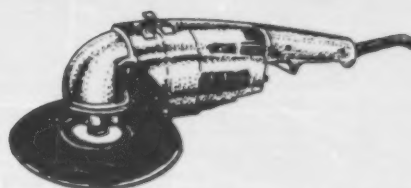


STIPPLING

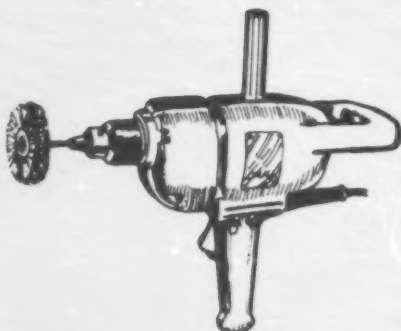
POWER CLEANING EQUIPMENT



BELT SANDER



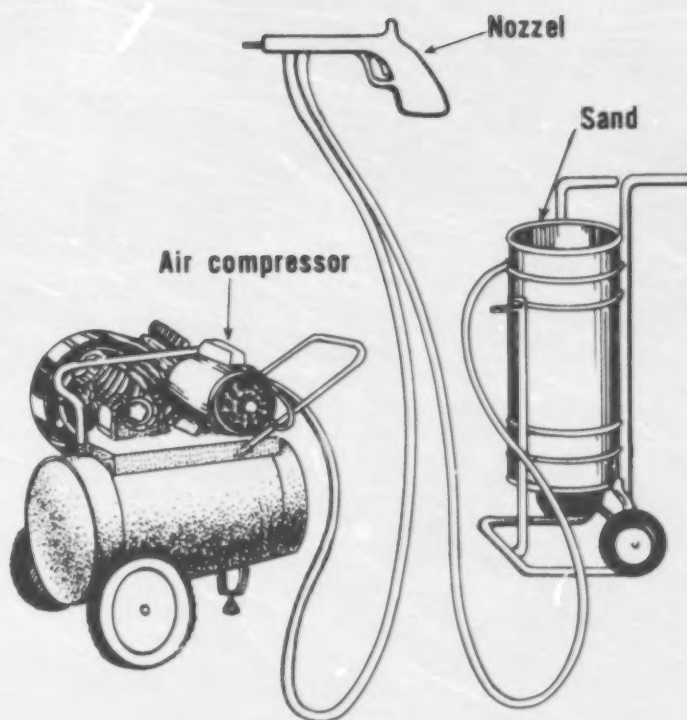
DISC SANDER



ELECTRIC WIRE WHEEL BRUSH

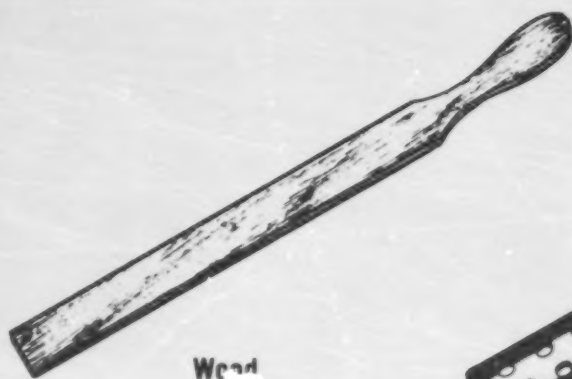


PROPANE TORCH



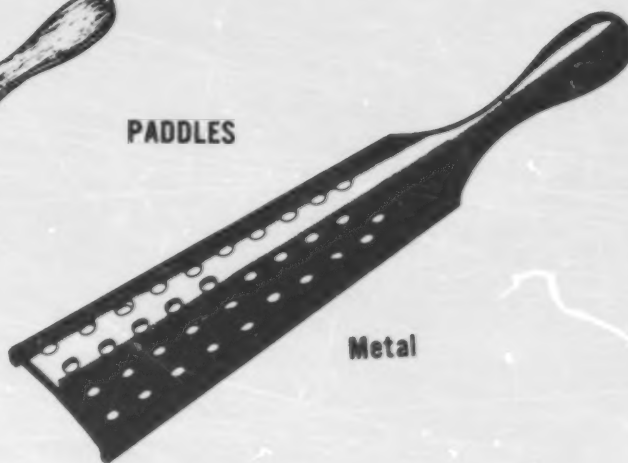
SAND BLASTER

TYPES OF HAND MIXERS

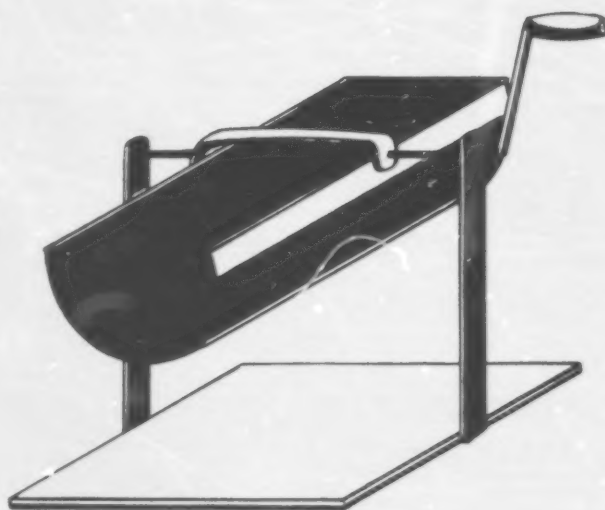


Wood

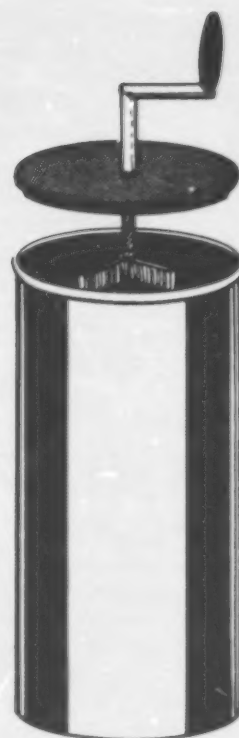
PADDLES



Metal



SHAKER

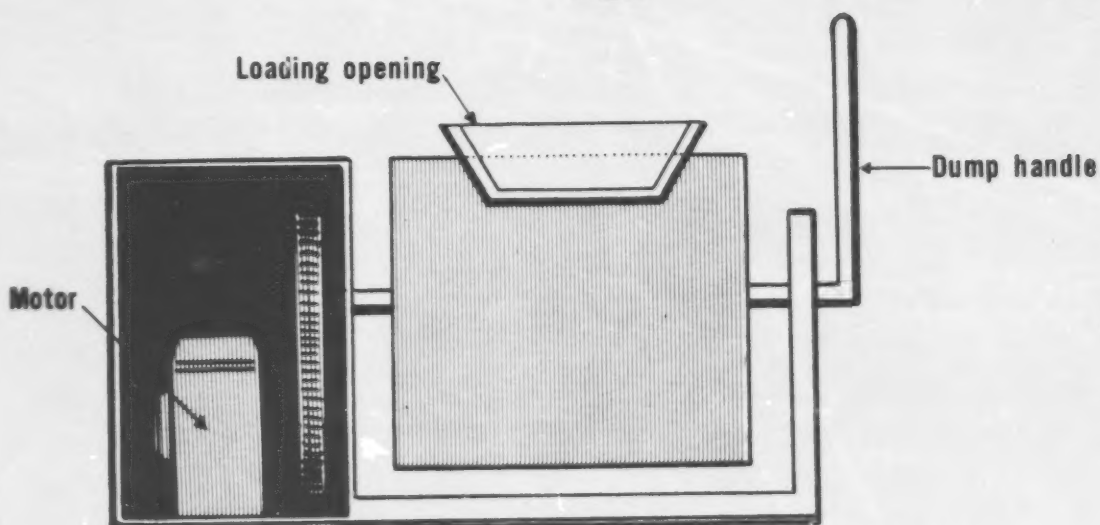
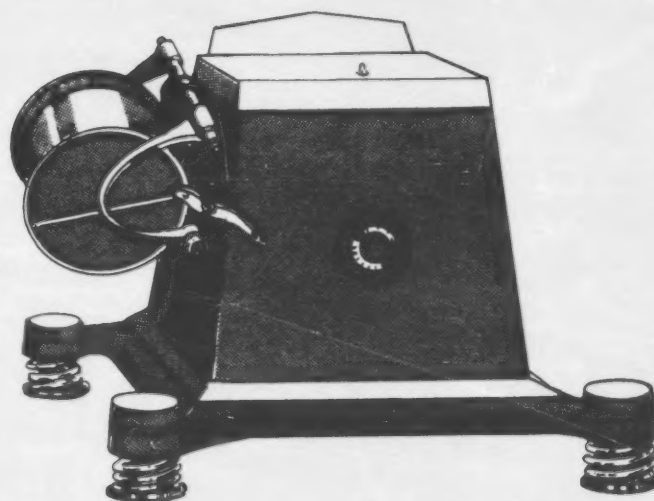


AGITATOR

TYPES OF POWER MIXERS

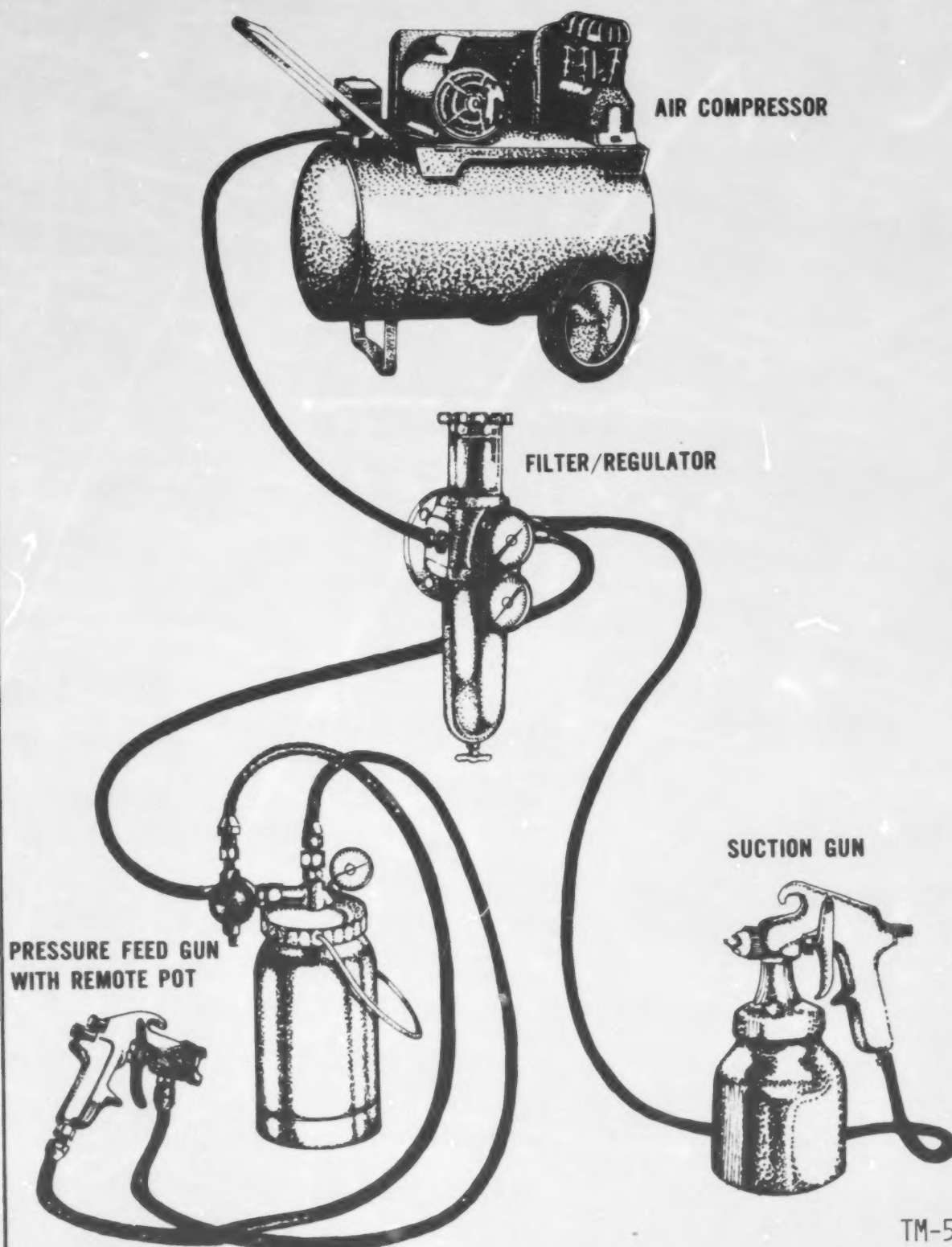


SHAKER



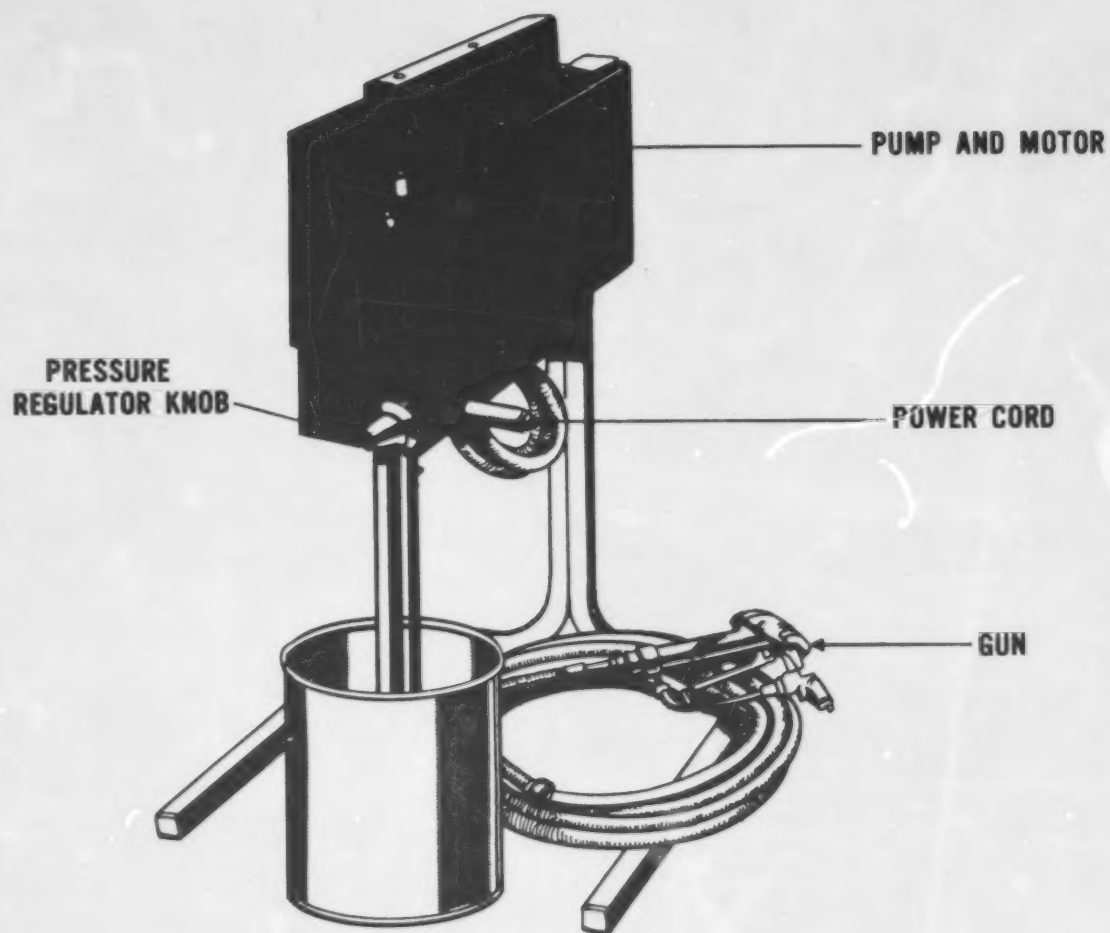
DRUM MIXER

COMPRESSED AIR SPRAYERS



TM-5

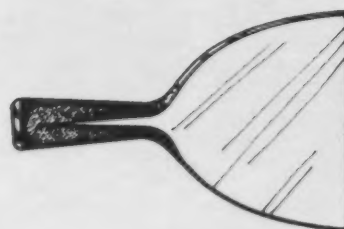
AIRLESS SPRAYER



DRYWALL TOOLS



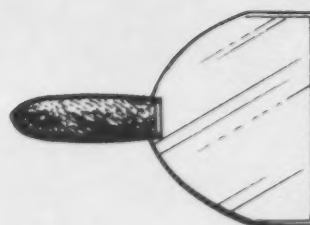
UTILITY KNIFE



JOINT KNIFE



ANGLE KNIFE

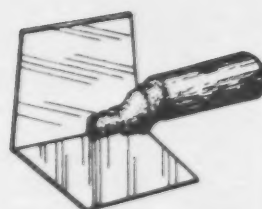


CORNER KNIFE



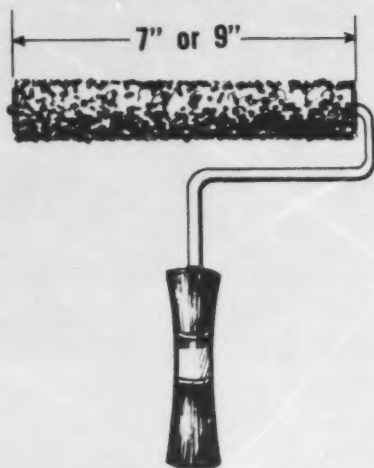
3/16"

JOINT TROWEL



CORNER TROWEL

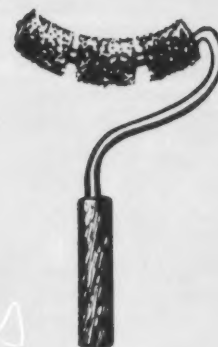
TYPES OF ROLLERS AND HANDLES



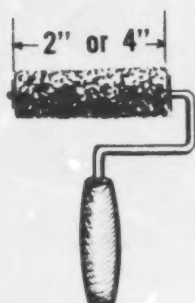
FLAT WALL



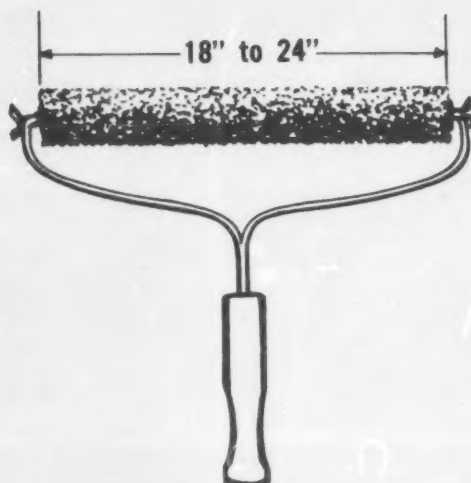
CORNER



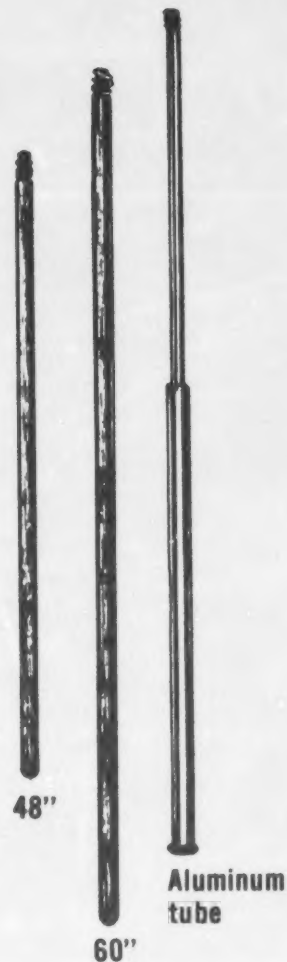
PIPE



TRIM



COMMERCIAL



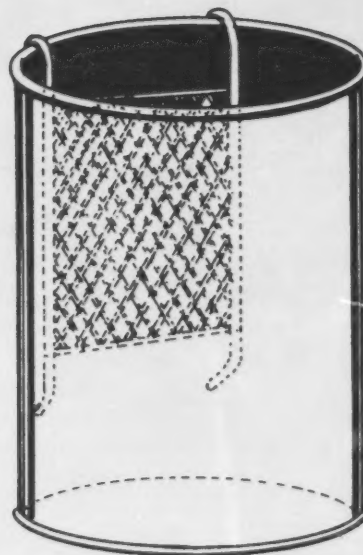
EXTENSION HANDLES

TM-8

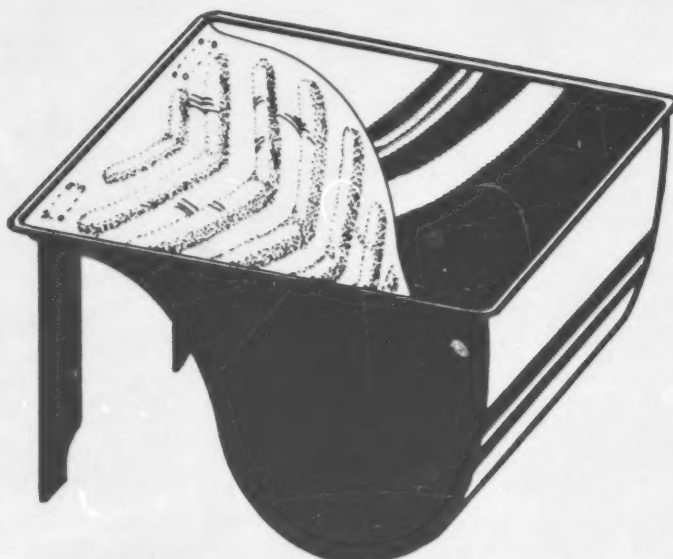
TYPES OF ROLLER PANS



PAN FOR 7" OR 9" ROLLER



ROLLER SCREEN FOR USE IN 5 GALLON CAN



COMMERCIAL ROLLER PAN FOR 18" OR 24" ROLLER

UNIT II

PAINTING TOOLS AND EQUIPMENT

ASSIGNMENT #1--IDENTIFY PAINTING TOOLS AND EQUIPMENT

Directions: The instructor will prepare a display of painting tools and equipment covered in the Information Sheet. A number will be assigned to each item. On a sheet of paper, write the correct name of each item beside the number of that item.

(NOTE: The instructor may provide a list of painting tools and equipment from which you can select your answer.)

UNIT II

PAINTING TOOLS AND EQUIPMENT

ASSIGNMENT SHEET #2--INSPECT PAINTING TOOLS AND EQUIPMENT

Directions: The instructor will display the tools and equipment to be used in this class. You are to check the condition of each item. On a sheet of paper, write any unsatisfactory condition you find. When you have finished your inspection, give your list to the instructor. The following are some areas you may want to inspect:

1. Stiff bristles on paint brushes
2. Broken handles
3. Dried paint on rollers
4. Frayed power cords
5. Clogged paint guns

UNIT II
PAINTING TOOLS AND EQUIPMENT

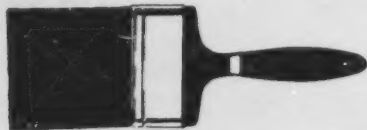
UNIT TEST

1. Match the terms in the righthand column to the correct definition on the left. Place the number in the blank.

- | | |
|--|----------------|
| _____ a. Frame around a window | 1. Accoustical |
| _____ b. Substance pur in paint that gives it color | 2. Synthetic |
| _____ c. Liquid mixed with pigment to make paint | 3. Nap |
| _____ d. Surface of paint roller | 4. Pigment |
| _____ e. Man-made | 5. Vehicle |
| _____ f. Any material that absorbs sound or noise | 6. Sash |
| _____ g. Animal hair or man-made fiber used to make paint brushes | 7. Bristle |
| _____ h. Covering nail holes and drywall joints by smoothing texture on with a joint knife | 8. Bedding |

2. Identify the types of brushes. Choose your answer from the list below and write it in the blank.

Flat sash and trim Wall Stippling Angular sash



a. _____



b. _____



c. _____



d. _____

3. Identify the cleaning equipment used in painting. Place a "✓" in the blank.

- _____ a. Propane torch
- _____ b. Acetylene torch
- _____ c. Sandblaster
- _____ d. Wire brush
- _____ e. Scraper
- _____ f. Electric sander
- _____ g. Wire wheel brush
- _____ h. Air brush

List three types of hand or power paint mixers.

- a. _____
- b. _____
- c. _____

5. Identify the true statements about paint covers and cloths. Place a "✓" in the blank.

- ____ a. Drop covers are made of cotton ducking or plastic.
- ____ b. Cotton batting is used to protect furniture from damage.
- ____ c. Plastic tarp is used to cover paint cans.
- ____ d. Cheesecloth is a closed weave, coarse material.
- ____ e. Canvas is a soft, open weave cotton material.

6. List the two kinds of paint sprayers.

- a. _____
- b. _____

7. Identify the drywall tools. Choose your answer from the list below and write it in the blank.

Utility knife
Joint knife
Joint trowel

Corner knife
Corner trowel
Angle knife



a. _____



b. _____



c. _____



d. _____



e. _____



f. _____

8. Identify the types of paint rollers. Select the correct answer from the list and write it in the blank below.

Pipe

Corner

Commercial

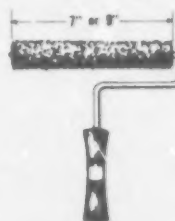
Flat wall

Trim

a. _____



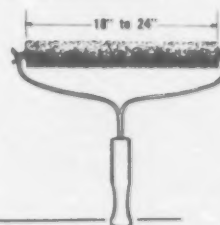
d. _____



b. _____



e. _____



c. _____



9. List three miscellaneous tools and materials used by painters.

a. _____

b. _____

c. _____

10. Demonstrate the ability to:

a. Identify painting tools and equipment.

b. Inspect painting tools and equipment.

(Note: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT II
PAINTING TOOLS AND EQUIPMENT

ANSWERS TO UNIT TEST

1. 6 a.
4 b.
5 c.
3 d.
2 e.
1 f.
7 g.
8 h.
2. a. Wall
b. Angular sash
c. Stippling
d. Flat sash and trim
3. ✓ a.
 b.
✓ c.
✓ d.
✓ e.
✓ f.
✓ g.
 h.
4. Any three of these:
a. Flat paddle

- b. Hand shaker
- c. Hand agitator
- d. Power agitator
- e. Power shaker
- f. Power drum

5. ☒ a.
☒ b.
☐ c.
☐ d.
☐ e.

6. a. Compressed air
b. Airless

7. a. Joint knife
b. Corner trowel
c. Angle knife
d. Utility knife
e. Corner knife
f. Joint trowel

8. a. Corner
b. Trim
c. Pipe
d. Flat wall
e. Commercial

9. Any three of these:
 - a. Caulking gun
 - b. Pails or buckets
 - c. Perforated paper tape
 - d. Masking tape
10. Evaluated to the satisfaction of the instructor.

UNIT III

WALL PREPARATION AND PRIME COATING

UNIT OBJECTIVE

After completing this unit, the student will be able to prepare and prime coat a wall. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with wall preparation and painting.
2. Select procedures involving wall preparation.
3. List methods of mixing primer.
4. List methods of applying primer.
5. Select procedures for drying time of primer.
6. Point out the general application of primer.
7. Identify the characteristics of putty and explain caulking procedures.
8. Demonstrate the ability to:
 - a. Prepare a new interior wall.
 - b. Prepare a new wood wall.
 - c. Prepare an old interior wall.
 - d. Prepare an old wood wall.
 - e. Prime coat a wall with a brush.
 - f. Prime coat a wall with a sprayer.
 - g. Prime coat a wall with a roller.

UNIT III

WALL PREPARATION AND PRIME COATING

SUGGESTED ACTIVITIES

- I. Instructor:
 - A. Discuss unit objectives
 - B. Provide students with information and job sheets
 - C. Prepare transparencies
 - D. Prepare demonstrations
 - E. Give test
 - F. Review problem areas identified by test
- II. Student:
 - A. Discuss questions of unit objectives
 - B. Read and discuss information and job sheets
 - C. Complete job sheets
 - D. Take test
 - E. Discuss questions missed on test

INSTRUCTIONAL MATERIALS

- I. Included in this unit:
 - A. Objective sheet
 - B. Information sheet
 - C. Transparency masters
 - 1. III-TM-1--Taping and Bedding
 - 2. III-TM-2--Applying Paint With a Brush
 - 3. III-TM-3--Applying Paint With a Sprayer
 - 4. III-TM-4--Applying Paint With a Roller

D. Job Sheets

1. Job Sheet #1--Prepare a New Interior Wall
2. Job Sheet #2--Prepare a New Wood Wall
3. Job Sheet #3--Prepare an Old Interior Wall
4. Job Sheet #4--Prepare an Old Wood Wall
5. Job Sheet #5--Prime Coat a Wall With a Brush
6. Job Sheet #6--Prime Coat a Wall With a Sprayer
7. Job Sheet #7--Prime Coat a Wall With a Roller

E. Unit test

F. Answers to unit test

II. References

- A. Painting and Decorating Encyclopedia, Homewood, Illinois: The Goodheart-Wilcox Co., Inc., 1964.
- B. Feirer, John L. and Hutchings, Gilbert R. Carpentry and Building Construction. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1976.
- C. General Construction Trades. Stillwater, Oklahoma: State Department of Vocational and Technical Education, 1971.

UNIT III

WALL PREPARATION AND PRIME COATING

INFORMATION SHEET

I. Terms and Definitions

- A. Oil base--Paints that use some form of oil as the vehicle
- B. Water base--Paints that use water as the vehicle
- C. Latex--Synthetic, water-based paint
- D. Sealer--Clear, oil-based liquid used to prevent surfaces from absorbing too much paint
- E. Viscosity--A measurement of the thickness or thinness of paint
- F. Thinner--A liquid used to lower paint viscosity to make it flow and spread easily
- G. Caulking--Soft, elastic compound used to water-proof around windows, doors, openings, and cracks and applied from a cartridge with a caulking gun

caulking compound



- H. Putty--Thick, doughy compound used to fill small cracks and nail holes



- I. Primer--Paint with high percentage of vehicle used to prepare surfaces before applying finish paint coat
- J. Enamel undercoat--Paint used as a base or primer coat under enamels to bond the enamel to the wood
- K. Spackling compound (joint compound)--Used to cover nail heads and bed perforated paper tape
(Note: Perforated paper tape is also called spackle tape or drywall tape.)

1. Premixed--Comes in box or can



2. Powder--To be mixed with water

II. Wall preparation

- A. Set nails--Drive the nail head below the wall surface from $1/16$ " to $1/8$ "

1. Nails are set so they can be covered
2. Exterior nails are set to keep them from rusting
3. Interior nails are set to give added strength and appearance
4. Putty or spackling compound is used to cover nail heads

- B. Taping and bedding (Transparency #1)

1. Perforated paper tape is bedded on drywall joints
2. Provides for better insulation by sealing joints
3. Provides a smooth, even wall finish
4. Sides of sheetrock are tapered to allow for thickness of tape and forms a tapered joint
5. Ends of sheetrock are flat to form flat joints
6. A bed of spackling compound must surround the tape for proper seal and holding power
7. Flat joints are not as thick as tapered joints

III. Methods of mixing primer

(CAUTION: Always read directions on container before mixing since some paints cannot be shaken.)

- A. Oil base

1. Shake unopened can
 - a. Hand shaker
 - b. Power shaker
2. Stir
 - a. Pigment will settle to bottom of can
 - b. All but about one inch of oil is poured off top into clean container
 - c. Pigment and oil are stirred with paddle or electric mixer
 - d. Oil that was poured off is gradually stirred with primer
 - e. Proper type of thinner is added if primer is too thick
 - f. Primer is poured back and forth between two containers to assure complete mixing

B. Latex

1. Shake unopened can
 - a. Hand shaker
 - b. Power shaker
2. Stir
 - a. Do not pour off any liquid
 - b. Stir with paddle or electric mixer
 - c. Latex paint is thick and should not be thinned except for spray paint
 - d. Pour back and fourth between two containers to assure complete mixing

C. Enamel undercoat

(CAUTION: Stir only since shaking causes bubbling.)

1. Shake unopened can
 - a. Hand shaker

b. Power shaker

2. Stir--Use same procedure as for stirring oil-base primer

D. Wood sealer

(CAUTION: Stir only, since shaking causes bubbling.)

1. Half of sealer is poured into clean container
2. Each container is stirred with a flat paddle (NOTE: Electric mixer can also cause bubbling.)
3. Sealer is poured back and forth between the two containers to assure complete mixing

E. Masonry block filler

1. Can be stirred or shaken
2. Extremely heavy with pigment and must be mixed thoroughly
3. Power mixers should be used, if possible
4. Thin only if directions permit

IV. Methods of applying primer

A. Brush (Transparency #2)

1. Clean container is filled 1/3 full of mixed primer
2. Dip 1/3 of brush bristle length into paint
3. Tap brush from side to side in can to remove excess paint from bristles
4. Do not rake brush across rim of can since it will remove too much paint from bristles and make a mess
5. Follow grain of wood with brush strokes
6. Overlap painted areas about three to four inches and gradually raise brush from surface toward end of stroke

7. Do not try to cover too large an area since overlapping should be on wet paint

B. Spray (Transparency #3)

1. Thin paint for sprayer application viscosity
2. Pour into paint gun can
3. Adjust air and paint flow while spraying scrap material
(NOTE: Your instructor will demonstrate how to adjust the particular gun your class will use.)
4. Hold gun six to eight inches from surface and aimed straight at surface
(NOTE: Holding gun too close causes paint to run and too far causes rough, sandy finish.)
5. Gun is moved from side to side in long strokes, and trigger is released just before the end of the stroke
6. Overlap each stroke by one-third the width of spray pattern
7. Spray a vertical stroke at the end of the wall section to complete paint cover
8. Two thin coats of spray paint are better than one thick coat

C. Roller

1. Fill roller pan about two-thirds full of paint
2. When using latex paint, nap of roller is wet with water, and excess water is removed by slinging roller
(NOTE: When using oil-base paints, nap is left dry.)
3. Roller is started at shallow end of pan and rolled down into paint several times until roller is covered with paint
4. Paint is absorbed into roller by rolling across shallow end of pan
5. Roller is started at top of wall and worked down

6. Brush on corner roller is used on wall corner
7. Handle extension should be used for ceilings and high walls
8. Tap each roller stroke one-half of roller width
9. When large area has been covered, roll side to side to hide lap lines

V. Drying time

- A. Oil base--Should be allowed to dry overnight
- B. Latex--Four to six hours in warm, dry hours or overnight in cool, damp areas
- C. Enamel undercoat--Should dry overnight or if using a fast, dry type about six hours
- D. Wood sealers--Usually four to six hours
- E. Masonry block filler--Usually four to six hours or overnight in cool, wet areas
(NOTE: Always read directions on container.)

VI. Applications of primer

A. Exterior

1. Oil base--Wood or metal
2. Latex--Wood, non-rusting metal and masonry
3. Enamel undercoat--Wood or metal
4. Wood sealer--Wooden doors and finish trim
5. Masonry block filler--Brick, stone, block, or concrete

B. Interior

1. Oil base--Wood or metal
2. Latex--Wood, non-rusting metal or masonry
3. Enamel undercoat--Wood or metal
4. Wood sealer--Wooden doors, cabinets, paneling, and trim

5. Masonry block filler--Brick, stone, block, or concrete

VII. Caulking and puttying
(Note: Always prime coat wall surfaces before caulking or puttying.)

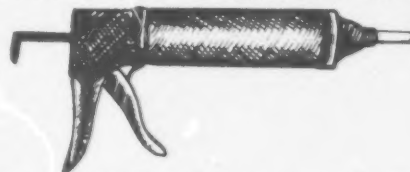
A. Caulking

1. Types of caulk

- a. Gun grade--Used under oil-base paints and must be protected from weather with paint coat on top
- b. Latex--Used under all types of paint
- c. Rubber or silicone--Used for waterproofing and long-lasting quality

2. Use of caulking gun

- a. Cartridge is inserted, and nozzle is cut off at an angle



- b. Gun is held at about 30° angle to surface
- c. Leave an excess of caulk to allow for smoothing with putty knife
- d. Work quickly to finish before surface dries
- e. For deep cracks use two applications
(Note: Allow first application to dry before applying a second.)
- f. Allow caulk to dry before painting

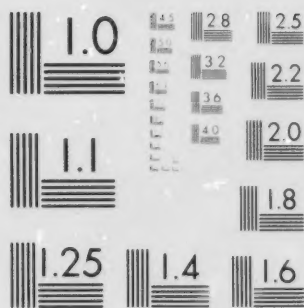
B. Putty

1. Types of putty

- a. Spackling--Vinyl putty used to fill cracks and nail holes for very smooth surface
- b. Linseed oil putty--Fiber and linseed oil putty for general use



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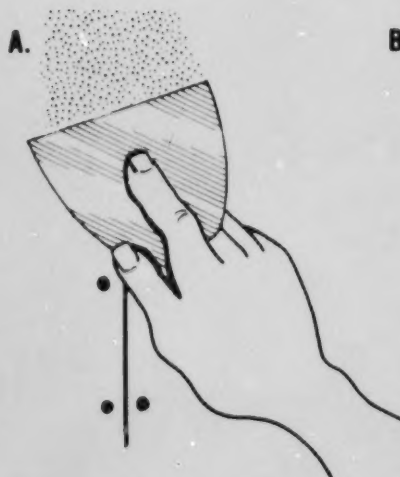
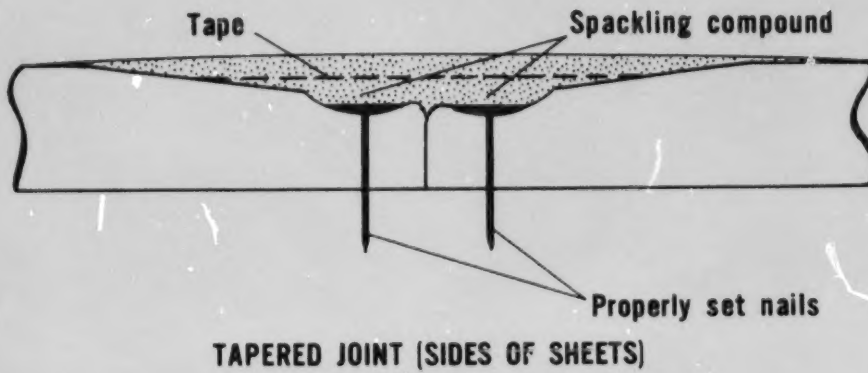
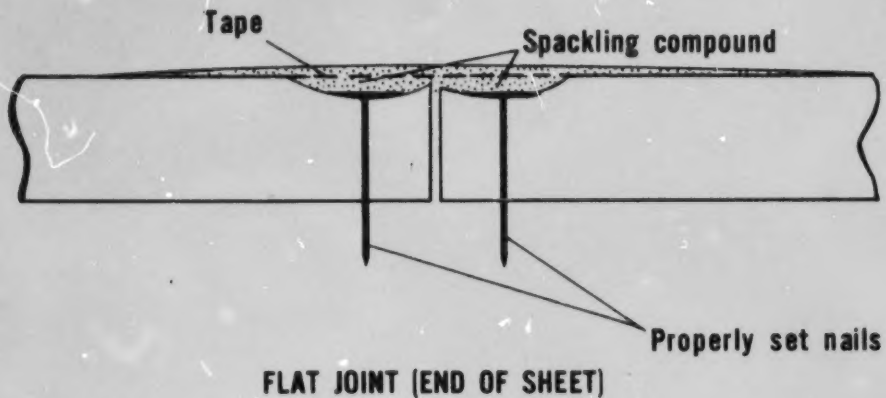
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

2. Applying putty

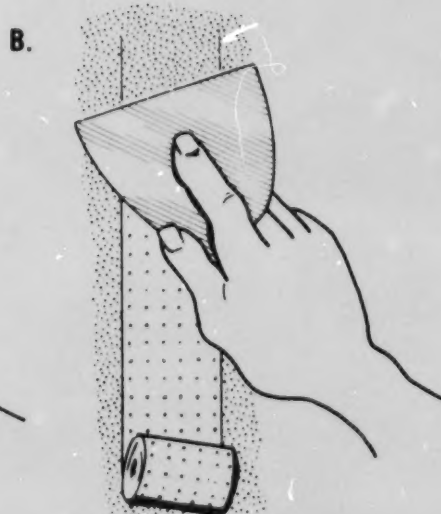
- a. Whip putty until smooth
- b. Putty knife or finger is used to press putty into hole or crack
- c. Hole or crack should be slightly over-filled with putty
- d. Putty knife is scraped across at 20° angle to surface to smooth putty
- e. Putty is left slightly above the surface to allow for shrinkage
- f. Clean rag is used--wipe off excess putty
- g. After drying, putty may be sanded for extra smoothness

TAPING AND BEDDING

III-13



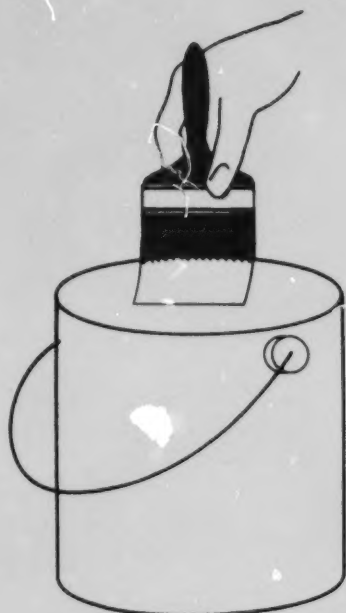
**A. FILL JOINT AND COVER
NAILS WITH SPACKLING**



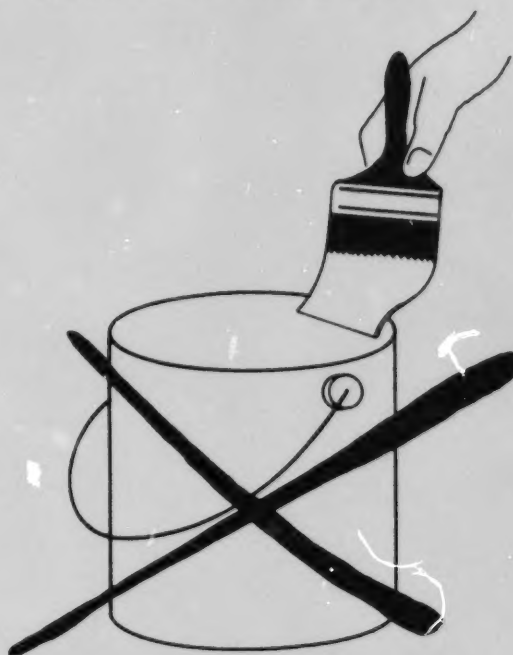
**B. EMBED THE PERFORATED
TAPE IN SPACKLING**

TM-1

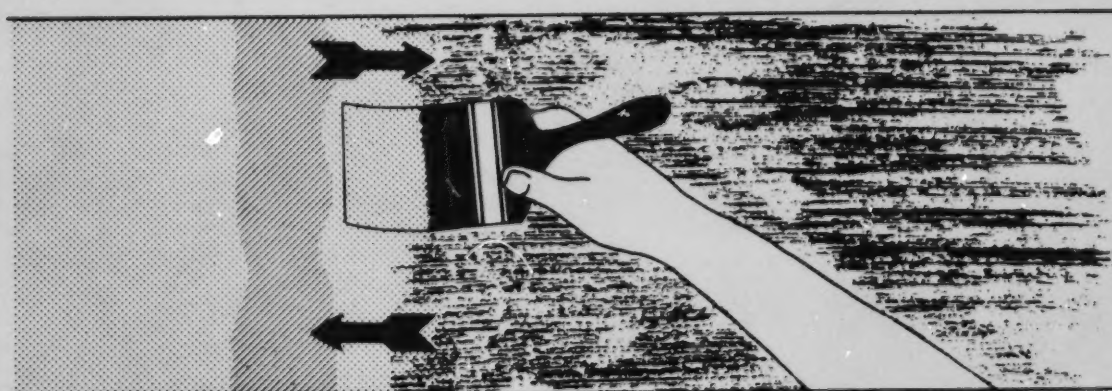
APPLYING PAINT WITH A BRUSH



RIGHT



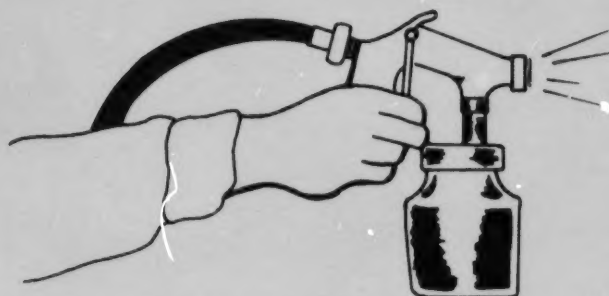
WRONG



LAP
OVER WET
SURFACE

PAINT WITH GRAIN

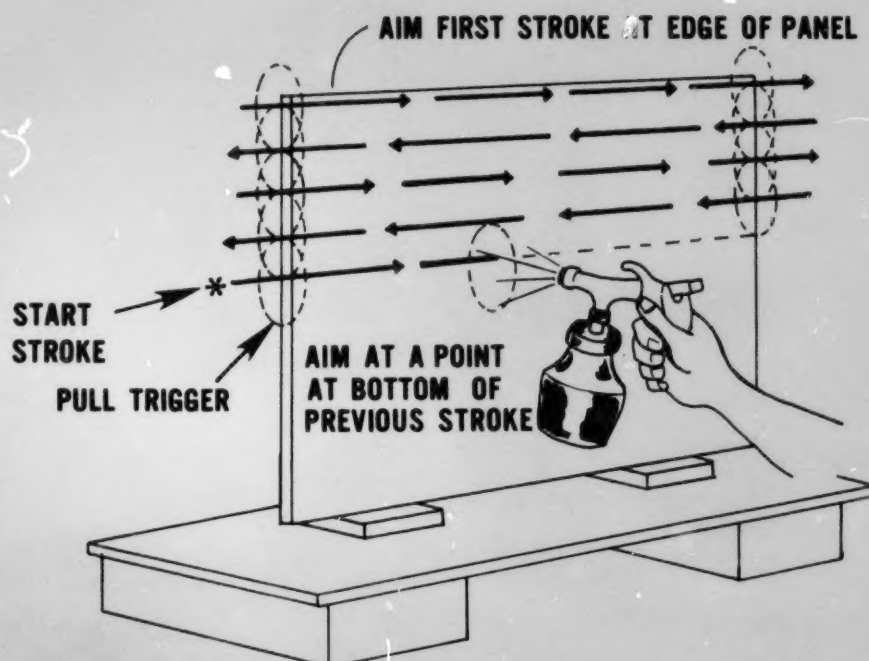
APPLYING PAINT WITH A SPRAYER



SPRAYING TOO CLOSE PAINT GOES ON TOO HEAVY, AND TENDS TO SAG

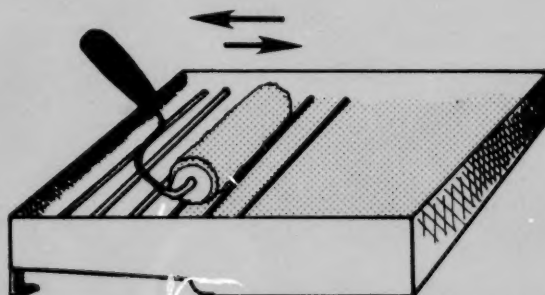
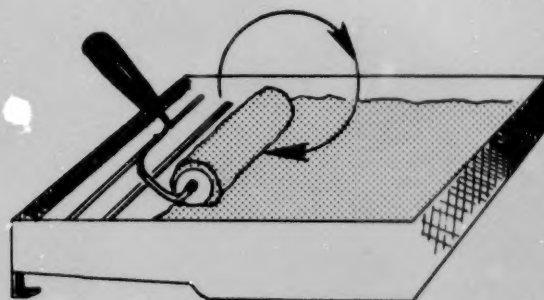


SPRAYING TOO FAR MAKES FOR EXCESSIVE DUSTING, RESULTS IN A SANDY FINISH



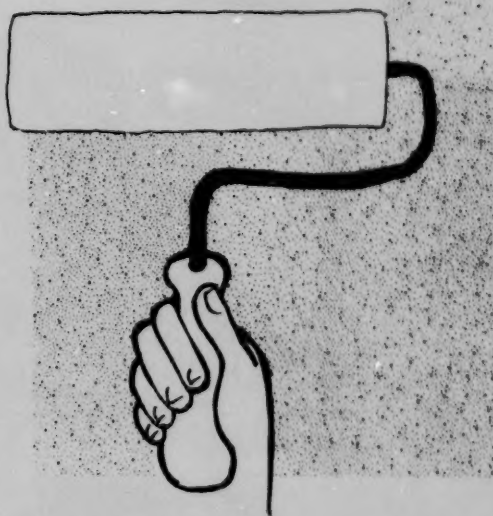
APPLYING PAINT WITH A ROLLER

STEP 1: Roller is rolled down into paint, lifted out of paint and repeated



STEP 2: Paint is absorbed into roller by rolling back and forth

START AT TOP OF WALL



UNIT III

WALL PREPARATION AND PRIME COATING

JOB SHEET #1--PREPARE A NEW INTERIOR WALL

I. Tools and materials

- A. Hammer (13 oz.)
- B. Joint knife
- C. Joint trowel
- D. Spackling compound
- E. Perforated paper tape
- F. Sandpaper

II. Procedure

- A. Set all nails just below the surface to allow for bedding, using the hammer
(NOTE: Do not break the paper covering of the drywall when setting nails)
- B. Pull off all loose paper from edges of drywall sheets
- C. Sand all rough edges
- D. Prepare the spackling compound according to container instructions
- E. Tape and bed all joints
(NOTE: Refer to TM-1 for details)
- F. After first coat has dried, apply a second coat over joints
- G. Bed all nails
(NOTE: If any part of the joint knife touches the nail head, reset the nail)
- H. Float all joints
- I. Smooth all rough areas with sandpaper
- J. Clean and store tools properly

UNIT III

WALL PREPARATION AND PRIME COATING

JOB SHEET #2--PREPARE A NEW WOOD WALL

I. Tools and materials

- A. Hammer (13 oz.)
- B. Nail set
- C. Sandpaper and sanding block
- D. Paint brush
- E. Wood sealer
- F. Ladder (if needed)
- G. Safety glasses or goggles

II. Procedure

- A. Set all nails 1/16 to 1/8 inch below the surface
(CAUTION: Safety glasses should be worn at all times)
- B. Apply sealer to all knots in the wood using the brush
- C. Sand all rough surfaces
 - 1. Sand with the grain of the wood
 - 2. Use 280 grit or finer sandpaper
- D. Let sealer dry before sanding near area with sealer
- E. If wall is to be painted, cover nail holes with putty
- F. Clean and store tools properly
- G. Wash your hands

UNIT III

WALL PREPARATION AND PRIME COATING

JOB SHEET #3--PREPARE AN OLD INTERIOR WALL

I. Tools and materials

- A. Hammer (13 oz.)
- B. Joint knife
- C. Joint trowel
- D. Utility knife
- E. T-square
- F. Half-inch sheetrock
- G. Sheetrock nails
- H. Perforated paper tape
- I. Safety glasses

II. Procedure

- A. Replace all damaged material
(NOTE: Care must be taken to cut straight when removing old sheetrock)
- B. Reset any loose nails and add nails where necessary
- C. Tear off any loose tape or paper
 - 1. Re-sand area around joint for smooth base
 - 2. Check nails for set
- D. Tape and bed all joints where tape has been removed
(NOTE: Be sure surface level of new tape is even with old tape)
- E. Bed all nails
- F. Float all rough spots
- G. Sand all rough areas when dry
- H. Clean and store tools properly

UNIT III

WALL PREPARATION AND PRIME COATING

JOB SHEET #4--PREPARE AN OLD WOOD WALL

I. Tools and materials

- A. Scraper
- B. Hammer (13 oz.)
- C. Nail set
- D. Ladder (if necessary)
- E. Putty and putty knife
- F. Wood chisel
- G. Safety glasses

II. Procedure

- A. Scrape entire surface thoroughly
 - 1. Scrape with the wood grain
 - 2. Do not scrape into wood
 - 3. It is not necessary to scrape off all the old paint if it will not affect the finished appearance
- B. Replace all damaged material
 - 1. Chisel or cut out
 - 2. Replace with new material
 - 3. Set all nails
 - 4. Sand all joints smoothly
- C. Reset all old nails
- D. Putty all nail holes and joints
- E. Sand all rough areas
 - 1. Use fine sandpaper
 - 2. Sand with the grain

F. Clean and store tools properly'

G. Wash your hands

UNIT III

WALL PREPARATION AND PRIME COATING

JOB SHEET #5--PRIME COAT A WALL WITH A BRUSH

I. Tools and materials

- A. Paint cloths and covers
- B. Paint brushes (wall and trim)
- C. Flat paddle
- D. Clean container for primer
- E. Primer
- F. Thinner or solvent (if necessary)

II. Procedure

- A. Spread paint cloths and covers over floors and furniture
- B. Read directions on primer container
- C. Mix primer according to directions on container and Part III of the information sheet
(NOTE: Be sure you have good ventilation)
- D. Dip brush one-half to one-third of length of bristles into primer
- E. Apply primer to wall according to Part IV of the information sheet
- F. Use trim brush for trim and sash brush for windows
- G. Check to be sure no areas were missed
- H. Clean brushes using solvents recommended on container label
- I. Store all used rags properly
- J. Clean and store equipment properly
- K. Wash your hands

UNIT III

WALL PREPARATION AND PRIME COATING

JOB SHEET #6--PRIME COAT A WALL WITH A SPRAYER

I. Tools and materials

- A. Paint cloths and covers
- B. Sprayer equipment (air compressor, regulator, hoses, gun, etc.)
- C. Flat paddle or shaker
- D. Primer
- E. Thinner or solvent (if necessary)

II. Procedure

- A. Spread paint cloths and covers over floor and furniture
- B. Read directions on primer container
- C. Mix primer according to directions on container and Part III of the information sheet
(NOTE: Be sure you have good ventilation)
- D. Pour primer into sprayer pot
- E. Adjust air and fluid flow of spray gun
(NOTE: Ask your instructor for assistance in adjusting the type sprayer you will be using)
- F. Spray primer on wall according to directions in Part IV of information sheet
- G. When job is complete, clean and store equipment properly
(NOTE: Ask your instructor for proper sprayer cleaning instructions)

UNIT III

WALL PREPARATION AND PRIME COATING

JOB SHEET #7--PRIME COAT A WALL WITH A ROLLER

I. Tools and materials

- A. Paint cloths and covers
- B. Paint roller and pan
- C. Flat paddle or shaker
- D. Clean container for mixing
- E. Primer

II. Procedure

- A. Spread paint cloths and covers over floor and furniture
- B. Read directions on primer container
- C. Mix primer according to directions on container and Part III of the information sheet
(NOTE: Be sure you have good ventilation)
- D. Pour primer into roller pan so that the pan is two-thirds full
- E. Load roller with paint following directions in Part IV of the information sheet
- F. Apply primer to wall with roller following directions in Part IV of information sheet
- G. When job is complete, clean and store tools properly
- H. Wash your hands

UNIT III

WALL PREPARATION AND PRIME COATING

UNIT TEST

1. Match the terms in the right-hand column to the correct definitions on the left. Place the number in the blank.

- | | | |
|----------|--|-----------------------|
| _____ a. | Paints that use some form of oil as the vehicle | 1. Latex |
| _____ b. | Paints that use water as the vehicle | 2. Thinner |
| _____ c. | Synthetic, water-base paint | 3. Oil base |
| _____ d. | Paint with high percentage of vehicle used to prepare surfaces for finish coat | 4. Water base |
| _____ e. | A compound used to cover nail heads and bed perforated paper tape | 5. Spackling compound |
| _____ f. | A liquid used to lower paint viscosity to make it flow and spread easily | 6. Viscosity |
| _____ g. | A measurement of the thickness or thinness of paint | 7. Primer |

2. Select the true statement about wall preparation. Place a "✓" in the blank.

- | | |
|----------|--|
| _____ a. | Nails are set so they can be covered. |
| _____ b. | Putty or spackling compound is used to cover nail heads. |
| _____ c. | Perforated paper tape is the same as masking tape. |
| _____ d. | Masking tape is used to seal joints on sheetrock walls. |
| _____ e. | Sides of sheetrock are tapered. |

3. List two methods of mixing primer:

a.

b.

4. List three methods of applying primer:

- a.
- b.
- c.

5. Select the true statements about the drying time for primer:

- _____ a. Always read the directions on the container.
- _____ b. Drying time for latex primer is 48 hours.
- _____ c. Oil-base primer should be allowed to dry overnight.
- _____ d. Masonry block filler should dry 48 hours.
- _____ e. Enamel undercoat should dry overnight unless a fast-drying type is used.

6. Demonstrate the general applications of primer. Place a "✓" in the blank.

- _____ a. Windows and doors
- _____ b. Interior and exterior
- _____ c. Floors and ceilings

7. Identify the true statements about putty and caulking. Place a "✓" in the blank.

- _____ a. Gun grade, latex, and silicon are types of caulk.
- _____ b. A cartridge is used in a caulking gun.
- _____ c. The nozzle of the cartridge should not be cut off at an angle.
- _____ d. Spackling and linseed oil are two types of putties.
- _____ e. Putty should be mounded slightly higher than the hole or crack to be covered.

8. Demonstrate the ability to:
 - a. Prepare a new interior wall.
 - b. Prepare a new wood wall.
 - c. Prepare an old interior wall.
 - d. Prepare an old wood wall.
 - e. Prime coat a wall with a brush.
 - f. Prime coat a wall with a sprayer.
 - g. Prime coat a wall with a roller.

(NOTE: If these activities have not been completed prior to the test, ask your instructor when they should be completed.)

UNIT III

WALL PREPARATION AND PRIME COATING

ANSWERS TO UNIT TEST

1. 3 a. 5 e.4 b. 2 f.1 c. 6 g.7 d.2. ✓ a. d.✓ b. ✓ e. c.3. a. Shake
b. Stir4. a. Brush
b. Spray
c. Roller5. ✓ a. d. b. ✓ e.✓ c.6. a.✓ b. c.7. ✓ a.✓ b. c.✓ d.✓ e.

8. Evaluated to the satisfaction of the instructor.

UNIT IV
FINISH COATING

UNIT OBJECTIVE

After finishing this unit, the student will be able to apply a finish coat of paint, stain, or varnish to a wall. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions associated with finish coating of a wall
2. Select the characteristics of finish coating with paint
3. Select the characteristics of finish coating with stains
4. List types of uses for varnish
5. Demonstrate the ability to:
 - a. Finish coat a wall with paint
 - b. Finish coat a wall with stain
 - c. Finish coat a wall with varnish
 - d. Clean a paint brush
 - e. Clean a paint sprayer gun
 - f. Clean a paint roller used in latex paint

UNIT IV
FINISH COATING

SUGGESTED ACTIVITIES

- I. Instructor:
 - A. Discuss unit objective
 - B. Provide students with information and job sheets
 - C. Prepare transparencies
 - D. Give test
 - E. Review problem areas identified by test
- II. Student:
 - A. Discuss questions of unit objectives
 - B. Read and discuss information and job sheets
 - C. Complete job sheets
 - D. Take test
 - E. Discuss questions missed on test

INSTRUCTIONAL MATERIALS

- I. Included in this unit:
 - A. Objective sheet
 - B. Information sheet
 - C. Transparency masters
 - 1. IV-TM-1--Cutaway View of Spray Gun
 - 2. IV-TM-2--Types of Spray Gun Nozzles
 - D. Job sheets
 - 1. Job Sheet #1--Finish Coat a Wall With Paint
 - 2. Job Sheet #2--Finish Coat a Wall With Stain
 - 3. Job Sheet #3--Finish Coat a Wall With Varnish

4. Job Sheet #4--Clean a Paint Brush
5. Job Sheet #5--Clean a Paint Sprayer Gun
6. Job Sheet #6--Clean a Paint Roller Used in Latex Paint

E. Unit test

F. Answers to unit test

G. References

1. Painting and Decorating Encyclopedia. Homewood, Illinois: The Goodheart-Wilcox Co., Inc., 1964.
2. Feirer, John L. and Hutchings, Gilbert R. Carpentry and Building Construction. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1976.
3. General Construction Trades. Stillwater, Oklahoma: State Department of Vocational Education, 1971.

UNIT IV

FINISH COATING

INFORMATION SHEET

I. Terms and definitions

- A. Finish coat--The last coat of paint or stain applied to a surface
- B. Base coat--A coat of paint or stain applied before the finish coat
- C. Masking--Covering areas not to be painted with paper and masking tape
- D. Linseed oil--A liquid used to thin some oil-base paints and to clean painting equipment

II. Paints

(CAUTION: Most paints, stains, and varnishes are toxic and must be used in well-ventilated areas only)

A. Interior

- 1. All rough areas are sanded smooth
- 2. Check all putty and caulking
- 3. All sanding dust should be removed with a clean rag, air nozzle, or brush
- 4. Read directions on container before mixing
- 5. Methods of mixing are same as for primer or base coat
(NOTE: Refer to Unit III, Part III, for methods of mixing)
- 6. Can be applied with brush, roller, or sprayer
(NOTE: Good appearance depends on a properly applied finish coat. Proper procedures must be followed)

B. Exterior

- 1. Do not attempt to paint in wet weather
- 2. Primer or base coat must be completely dry

3. Check all putty and caulking
4. Mask all trim and areas not to be painted
5. Remove all dust and dirt from surface to be painted
6. Read directions on container and mix according to proper procedure
7. Can be applied with brush, roller, or sprayer

III. Stains

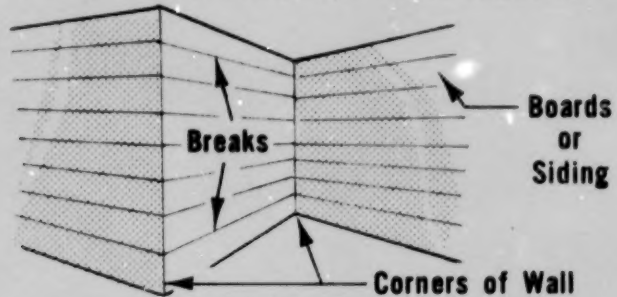
A. Interior

1. All base wood is sanded smooth
(NOTE: Be sure to sand with the wood grain only)
2. All grease, oil, pencil marks, or glue should be removed by sanding
3. Sanding dust must be removed with clean rag, brush, or air nozzle
4. Read directions on container and mix accordingly if mixing is necessary
5. May be applied with brush, cloth, or sprayer
(NOTE: Container directions may recommend method of application)
6. When applying with cloth, use canvas or chenille cloth to rub into wood
7. Soft, dry cloth is used to spread and remove excess stain

B. Exterior

1. Rough edges are sanded to acceptable smoothness with 180- or 200-grit sandpaper
(NOTE: Rough finished lumber needs no sanding)
2. Check all putty and caulking
3. Brush or air nozzle is used to remove all loose fibers and dust

4. Mask all areas not to be stained
5. Brush or sprayer is used to apply stain
(NOTE: Spray application is best for rough-finished wood surfaces)
6. Don't overlap dried, stained surfaces with wet stain
(NOTE: If possible, stop at breaks in wall surface to prevent overlaps from showing)



7. Must be applied evenly since second coats are not usually required

IV. Varnish

A. Interior

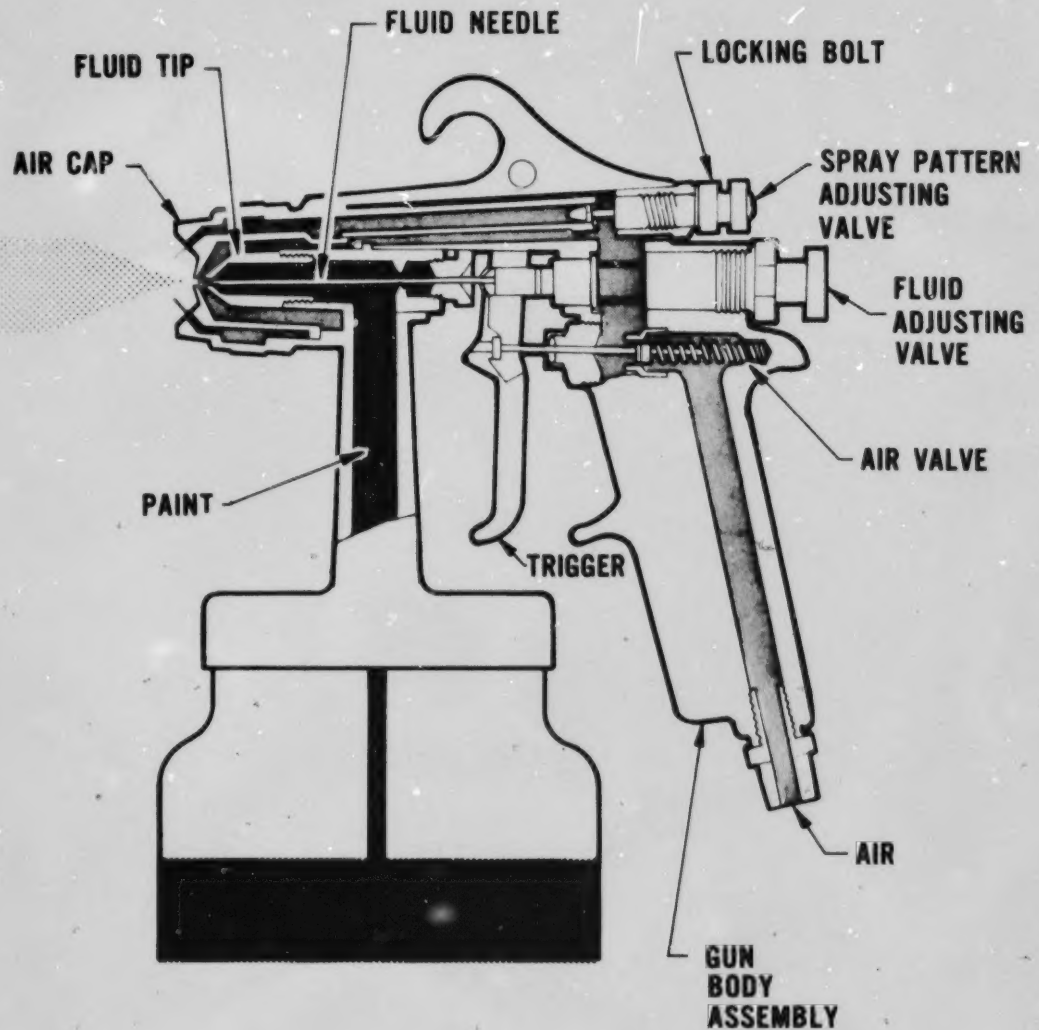
1. Read directions on container
2. Lightly sand sealer or stain coat with 200-grit sandpaper or 00 steel wool
(NOTE: If varnish is a stain varnish, sealer or stain coat may not be necessary)
3. Putty nail holes using matching color putty
4. Wipe sanding dust and excess putty from surface
5. Apply with brush or sprayer

B. Exterior

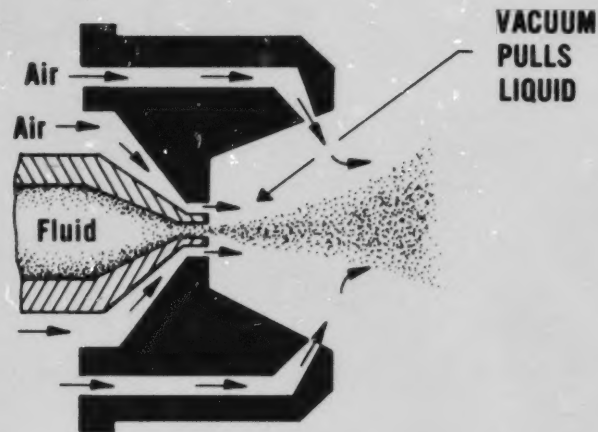
1. Read directions on container
2. Sand any rough areas, if necessary
3. Check all putty and caulking
4. Brush or use air nozzle to remove dust

5. Apply with brush or sprayer
6. Do not allow edge of varnished area to dry before total area to be varnished is completed

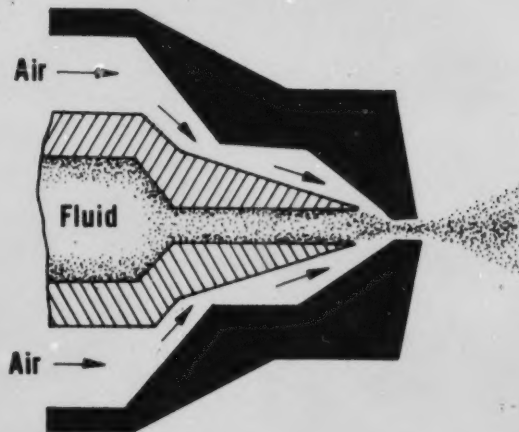
CUT-AWAY VIEW OF SPRAY GUN



TYPES OF SPRAY GUN NOZZLES



External Mix
AIR FLUID MIX OUTSIDE CAP



Internal Mix
AIR AND FLUID MIX INSIDE CAP

UNIT IV

FINISH COATING

JOB SHEET #1--FINISH COAT A WALL WITH PAINT

- I. Tools and materials
 - A. Paint cloths and covers
 - B. Flat paddle or shaker
 - C. Clean container for mixing
 - D. Paint (oil base or latex)
 - E. Thinner or solvent (if necessary)
 - F. Paint brush, roller, or sprayer
- II. Procedure
 - A. Be sure area is well ventilated
 - B. Spread paint cloths and covers over floor and furniture
 - C. Sand all rough areas
 - D. Remove sanding dust with clean, dry cloth, or air nozzle
 - E. Check putty and caulking
 - F. Mask off any trim or areas not to be painted
(NOTE: If applying paint with brush or roller, masking may not be necessary)
 - G. Read directions on container and mix accordingly
 - H. Apply paint using same procedure as for primer coat whether applying by brush, roller, or sprayer
 - I. Clean and store tools properly
(NOTE: Refer to Job Sheets #4 and 5 for proper clean-up procedure)

UNIT IV
FINISH COATING

JOB SHEET #2--FINISH COAT A WALL WITH STAIN

I. Tools and materials

- A. Paint cloths and covers
- B. Flat paddle
- C. Stain
- D. Thinner or solvent for cleaning
- E. Paint brush, sprayer, or clean cloth

II. Procedure

- A. Be sure area is well ventilated
- B. Spread paint cloths and covers over floor and furniture
- C. Smooth all rough areas with 200-grit sandpaper
- D. Remove sanding dust with clean, dry cloth
- E. Cover nail holes with putty recommended for use with stain.
(NOTE: If using colored stick type putty, nail holes are covered after staining)



Stick Putty

- F. Read directions on stain container for recommended method of application
- G. Test stain of scrap piece of same material used to build wall
- H. Apply stain using clean, dry, soft cloth with even amounts over entire surface
(NOTE: If using brush or sprayer, follow procedures in information sheet of Unit III, Part IV)
- I. Wipe excess stain off with clean, dry, soft cloth

J. Clean and store tools and materials properly

K. Wash your hands

UNIT IV
FINISH COATING

JOB SHEET #3--FINISH COAT A WALL WITH VARNISH

I. Tools and materials

- A. Paint cloths and covers
- B. Flat paddle
- C. Clean container for mixing
- D. Varnish
- E. Thinner or solvent
- F. Paint brush or sprayer

II. Procedure

- A. Be sure area is well ventilated
- B. Spread paint cloths and covers over floor and furniture
- C. Sand all rough areas
- D. Remove sanding dust with a brush, cloth, or air nozzle
- E. Check putty and caulking
- F. Mask off any areas not to be varnished
(NOTE: If using a brush, masking may not be necessary)
- G. Read directions on container and mix accordingly
- H. Apply varnish following procedures in the information sheet of Unit III, Part IV
- I. Clean and store tools and materials properly

UNIT IV
FINISH COATING

JOB SHEET #4--CLEAN A PAINT BRUSH

I. Tools and materials

- A. Solvent or thinner
- B. Clean container
- C. Used paint brush
- D. Plastic bags or heavy paper

II. Procedure

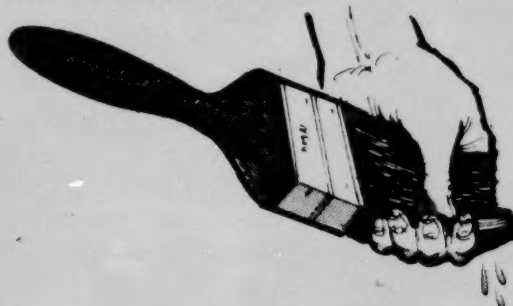
- A. Rake excess paint from bristles into paint can by pulling brush across the rim of the can
- B. Fill clean container with two to three inches of proper solvent for type of paint in brush
- C. Dip brush into solvent and work up and down, pushing heel of brush against bottom of can to force solvent through all the bristle length



- D. Work brush side-to-side in can to work solvent back and forth through bristles



- E. Lift brush and squeeze bristles between thumb and palm of hand to remove solvent and thinned paint from bristles



- F. Pour used solvent from cleaning can into a can that can be sealed
- G. Pour two to three inches of fresh solvent into can and repeat steps C, D, and E
- H. If brush is not completely clean, repeat steps C through E
- I. When bristles are clean, shake all solvent from brush
(NOTE: Do not slap brush against hard objects because it will loosen the bristles and ruin the brush)
- J. Wash bristles in warm, soapy water, rinse thoroughly, and hang to dry
- K. When dry, wrap in heavy paper or plastic bag and store flat or hung by handle
(NOTE: If paint has dried in the brush, it should be soaked in the proper solvent overnight, and a wire brush should be used to comb out softened paint)



UNIT IV

FINISH COATING

JOB SHEET #5--CLEAN A PAINT SPRAY GUN

I. Tools and materials

- A. Used paint spray gun
- B. Solvent
- C. Clean container for soaking
- D. Clean, soft cloth
- E. Linseed oil

II. Procedure

- A. Release pressure from sprayer container before opening
- B. Pour paint from reservoir back into paint container
- C. Rinse spray gun reservoir with solvent and pour into container holding used solvent
- D. Pour small amount of solvent into spray gun reservoir
(NOTE: Size of gun will determine amount of solvent to use)
- E. Close spray gun and connect air hose
- F. Spray solvent through gun
- G. Repeat steps D through F to complete internal cleaning
(NOTE: If paint has dried in spray gun, it will have to be disassembled and soaked in solvent overnight. Refer to Transparency #1.)
- H. Use clean, soft cloth and solvent to wipe all external surfaces clean
- I. Remove and clean inside of nozzle (Transparency #2)
- J. Replace nozzle on spray gun

- K. Pour small amount of linseed oil in sprayer reservoir and spray through the gun to lubricate and prevent rust on internal parts
- L. Wrap all external openings to keep dust out

UNIT IV
FINISH COATING

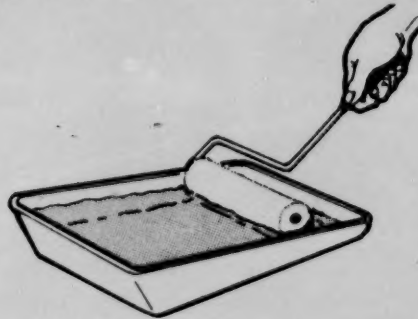
JOB SHEET #6--CLEAN A PAINT ROLLER USED IN LATEX PAINT

I. Tools and materials

- A. Used paint roller
- B. Roller pan
- C. Cleaning sink with running warm water
- D. Soap
- E. Solvent (for oil-base paints)

II. Procedure

- A. Squeeze excess paint from roller with putty knife or hand
- B. Rinse roller pan in sink under running warm water
(NOTE: Be sure to clean sink when finished cleaning roller pan)
- C. Fill roller pan with clean water
- D. Work roller in pan the same as for working paint into roller



- E. Run roller quickly over flat, clean surface to sling out water
(NOTE: Ask instructor where you should complete step E)
- F. Wash roller in bucket of warm water with mild soap
- G. Rinse again under running warm water and repeat step E

- H. Hang the paint roller by the frame to dry
- I. Hang the paint roller by the frame or remove the the roller cover and place the cover on a peg for storing
(NOTE: Do not allow the nap to touch any surface.

UNIT IV
FINISH COATING

UNIT TEST

1. Match the terms in the right-hand column to the correct definitions on the left. Place the number in the blank.

- | | | |
|----------|---|-------------------|
| _____ a. | The last coat of paint or stain applied to a surface | 1. Linseed oil |
| _____ b. | A coat of paint or stain applied before the finish coat | 2. Cottonseed oil |
| _____ c. | Mixed with some paints and used to clean painting equipment | 3. Finish coat |
| _____ d. | Cover areas not to be painted with paper and tape | 4. Base coat |
| | | 5. Mask |
| | | 6. Coating |

2. Select the correct statements about finish coating with paints. Place a "✓" in the blank.

- _____ a. Most paints are toxic and should be used in a well-ventilated area.
- _____ b. Mixing methods for finish coat are usually the same as for primer or base coat.
- _____ c. Finish coats are applied with a sprayer only.
- _____ d. Read directions on paint container only if all else fails.

3. Select the correct statements about finish coating with stains. Place a "✓" in the blank.

- _____ a. Stains may be of the interior or exterior type.
- _____ b. Surface of wood should not be sanded before staining.
- _____ c. Stain may be applied with brush, sprayer, or cloth.
- _____ d. Sprayer application works best for rough exterior surfaces.

4. List two types of uses for varnish:

a. _____

b. _____

5. Demonstrate the ability to:

a. Finish coat a wall with paint.

b. Finish coat a wall with stain.

c. Finish coat a wall with varnish.

d. Clean a paint brush.

e. Clean a paint sprayer gun.

f. Clean a paint roller used in latex paint.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT IV
FINISH COATING

ANSWERS TO UNIT TEST

1. 3 a.
 4 b.
 1 c.
 5 d.
2. ✓ a.
 ✓ b.
 c.
 d.
3. ✓ a.
 b.
 ✓ c.
 d.
4. a. Interior
 b. Exterior
5. Evaluated to the satisfaction of the instructor.

UNIT I

MASONRY TOOLS AND EQUIPMENT

UNIT OBJECTIVE

After completing this unit, the student will be able to identify masonry tools and equipment. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match the terms and definitions associated with masonry tools and equipment
2. Identify masonry hand tools
3. Select masonry equipment
4. List two items that are masonry power equipment
5. Demonstrate the ability to:
 - a. Identify masonry hand tools
 - b. Identify masonry equipment and power equipment

UNIT I
MASONRY TOOLS AND EQUIPMENT

SUGGESTED ACTIVITIES

- I. Instructor:
 - A. Discuss unit objective
 - B. Provide students with information and assignment sheets
 - C. Prepare transparencies and lesson plans
 - D. Discuss information and assignment sheets
 - E. Prepare display of masonry tools and equipment
 - F. Give unit test
 - G. Review problem areas identified by test
- II. Student:
 - A. Discuss questions of unit objective
 - B. Read and discuss information and assignment sheets
 - C. Complete assignment sheets
 - D. Take unit test
 - E. Discuss test questions missed

INSTRUCTIONAL MATERIALS

- I. Included in this unit:
 - A. Objective sheet
 - B. Information sheet
 - C. Transparency masters
 - 1. I-TM-1--Wheelbarrows
 - 2. I-TM-2--Scaffolds
 - 3. I-TM-3--Power Masonry Equipment

D. Assignment sheets

1. Assignment Sheet #1--Identify Masonry Hand Tools
2. Assignment Sheet #2--Identify Masonry Equipment and Power Equipment

E. Unit test

F. Answers to unit test

II. References:

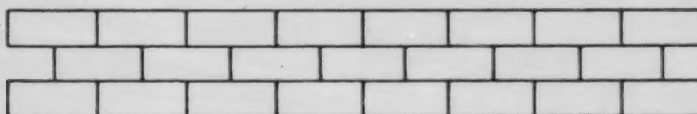
- A. Krek, Sr., R. T. Masonry Skills. Albany, New York: Delmar Publishers, 1976.
- B. Kicklighter, Clois E. Modern Masonry. South Holland, Illinois: Goodheart-Wilcox Co., Inc., 1977.
- C. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1976.

UNIT I
MASONRY TOOLS AND EQUIPMENT

INFORMATION SHEET

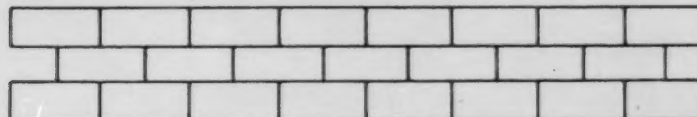
I. Terms and definitions

- A. Course--A layer of bricks, blocks, or stones in a wall



- B. Joint--The space filled with mortar between each brick
- C. Plumb--Means a wall is straight up and down and level
- D. Bed joint--The horizontal mortar joint between each layer or course of bricks
- E. Head joint--The vertical mortar joint between the ends of each brick

EXAMPLE:



- F. Tuck pointing--Putting fresh mortar into defective joints
- G. Muriatic acid--An acid combined with water and used to remove mortar from masonry

II. Masonry hand tools

A. Laying tools

1. Trowel--Used to lay and spread mortar

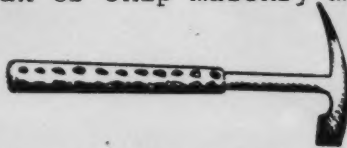


2. Brick chisel--A sharp tool used to cut brick to correct dimensions

(NOTE: Also called masons chisel.)



3. Brick hammer--Used to strike brick chisels and break or chip masonry materials



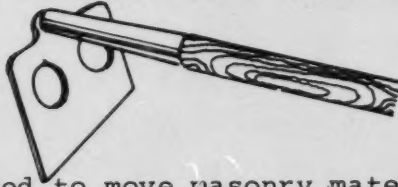
4. Masons level--A 42-to 48-inch straightedge tool used to plumb a wall



5. Spacing rule--A folding rule used to determine course height



6. Mortar hoe--A long handle tool used to mix mortar



7. Shovel--Used to move masonry materials such as sand and mortar

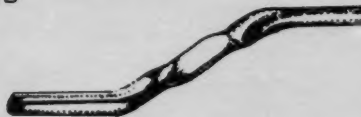


B. Finishing tools

1. Jointers--Used to finish the surface of mortar joints



- a. sled runner--Used to finish the bed joints



- b. S-shaped--Used to finish the head joints



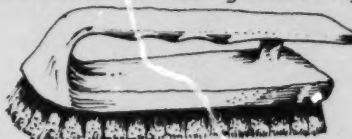
2. Joint raker--Used to finish the joints just before the mortar hardens



3. Tuck pointer joint filler--Used to put fresh mortar in bad joints



4. Masons utility brush--Used to brush off excess mortar after jointing



5. Acid brush--Used with muriatic acid to remove mortar



6. Brush brick--Used to remove dried excess mortar



III. Masonry equipment

A. Wheelbarrows (Transparency #1)

1. Contractors wheelbarrow--Used to move materials such as sand and mortar
2. Wooden wheelbarrow--Used to move materials such as concrete blocks and bricks

B. Mortar box--Used to hold mortar for mixing

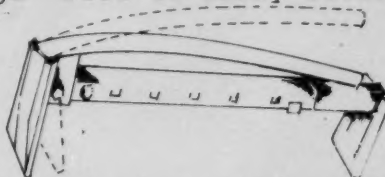


C. Mortar stand--Used to hold mortar within easy reach of mason



D. Scaffolds--Used to support the mason and materials being used (Transparency #2)

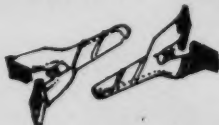
E. Brick tongs--Used to carry several bricks at a time



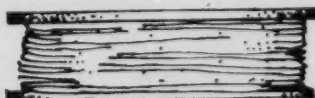
F. Corner poles--Used to hold a line for proper spacing of each course of bricks



G. Corner blocks--Used to hold the masons line



H. Masons line--A length of nylon string used to keep courses level and even



- I. Rubber gloves--Used when working with muriatic acid



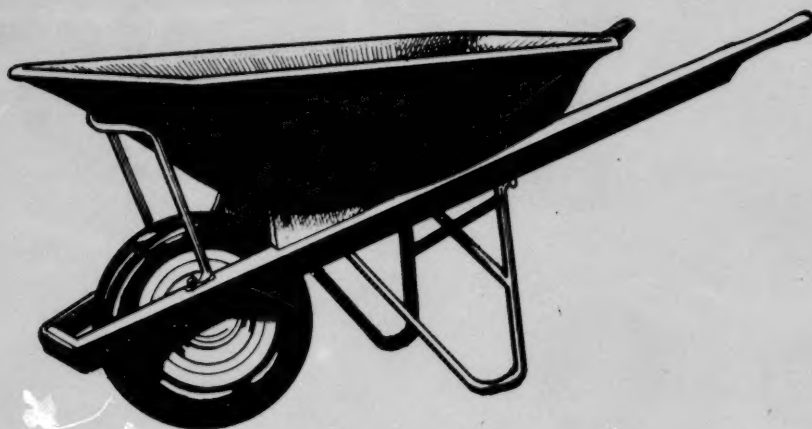
- J. Bucket--Metal or plastic, used for mixing water and muriatic acid



IV. Power masonry equipment (Transparency #3)

- A. Mortar mixer--Used to mix medium size amounts of mortar
- B. Masonry saw--Used to cut masonry blocks and bricks

WHEELBARROWS

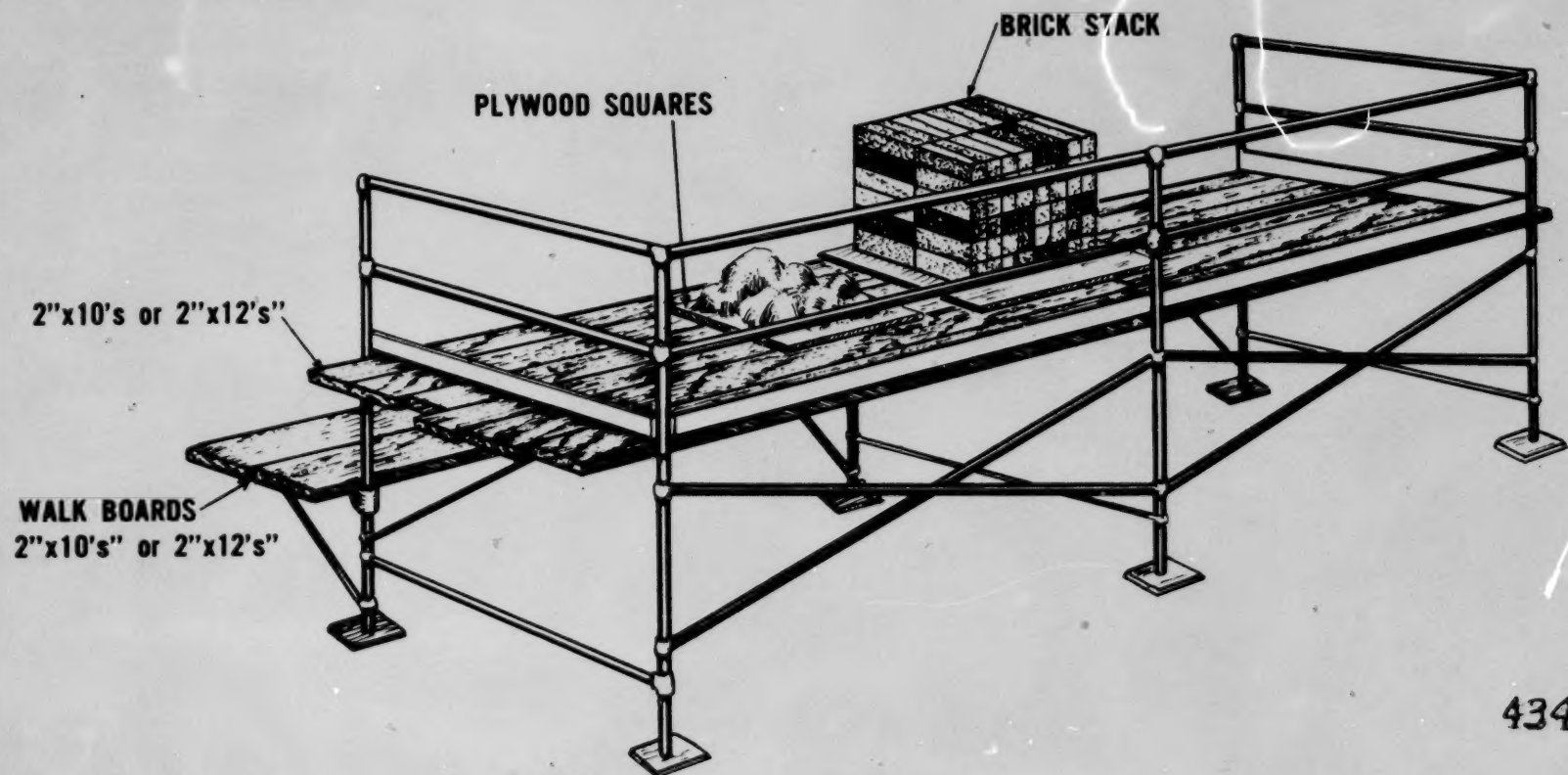


CONTRACTORS WHEELBARROW

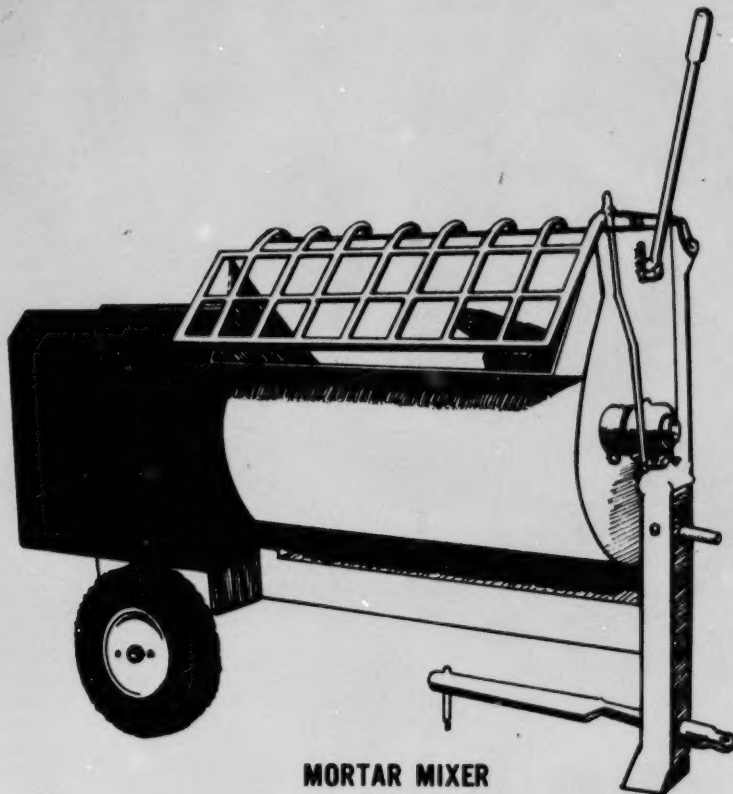


WOODEN WHEELBARROW

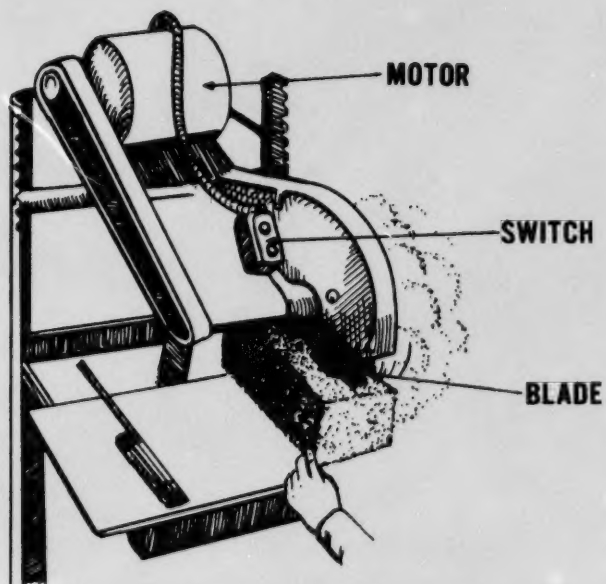
SCAFFOLDS



POWER MASONRY EQUIPMENT



MORTAR MIXER



MORTAR SAW
435

UNIT I

MASONRY TOOLS AND EQUIPMENT

ASSIGNMENT SHEET #1--IDENTIFY MASONRY HAND TOOLS

Directions: The instructor will prepare a display of each tool listed in Part II of the Information Sheet. Each tool will be assigned a number only. On a sheet of paper, write the correct name of each tool beside the number of that tool.

(NOTE: The instructor may provide a list of masonry tools from which you can select your answers.)

UNIT I

MASONRY TOOLS AND EQUIPMENT

ASSIGNMENT SHEET #2--IDENTIFY MASONRY EQUIPMENT
AND POWER EQUIPMENT

Directions: The instructor will prepare a display of each item listed in Parts III and IV of the Information Sheet. Each item will be assigned a number only. On a sheet of paper, write the correct name of each item beside the number of that piece of equipment.

(NOTE: The instructor may provide a list of masonry equipment terms from which you can select your answers.)

UNIT I

MASONRY TOOLS AND EQUIPMENT

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Evaluated to the satisfaction of the instructor

Assignment Sheet #2

Evaluated to the satisfaction of the instructor

UNIT I
MASONRY TOOLS AND EQUIPMENT

UNIT TEST

1. Match the masonry terms on the right to the correct definition on the left by placing the number in the blank.

- | | |
|---|---|
| <p>___ a. The space filled with mortar between each brick</p> <p>___ b. Means a wall is straight up and down and level</p> <p>___ c. The vertical mortar joint between the ends of each brick</p> <p>___ d. Putting fresh mortar into defective joints</p> <p>___ e. The horizontal mortar joint between each layer or course of bricks</p> <p>___ f. A layer of bricks, blocks or stones in a wall</p> | <p>1. Tuck pointing</p> <p>2. Head joint</p> <p>3. Bed joint</p> <p>4. Plumb</p> <p>5. Joint</p> <p>6. Course</p> |
|---|---|

2. Identify the following masonry hand tools and either a "laying tool" or "finishing tool" by writing either the word "laying" or "finishing" in the blank below each tool.



Trowel

a. _____



Brick chisel

b. _____



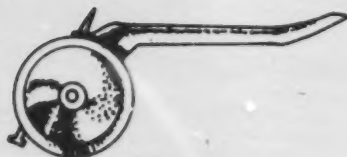
Brick hammer

c. _____



Masons level

d. _____



Joint raker

e. _____



Tuck pointer joint filler

f. _____



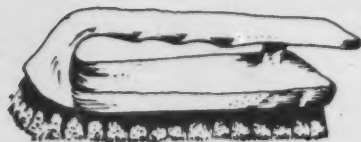
Mortar hoe

g. _____



Shovel

h. _____



Masons utility brush

i. _____

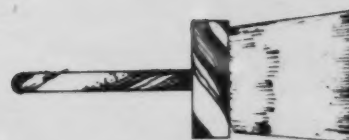


Spacing rule

j. _____



Brick brush



Acid brush

k. _____ 1. _____

3. Select the items below that are masonry equipment by placing a "/" in the blank.

- ___ a. Mortar box
- ___ b. Wooden wheelbarrow
- ___ c. Brick tongs
- ___ d. Jack plane
- ___ e. Scaffolds
- ___ f. Masons line
- ___ g. Rubber gloves
- ___ h. Corner blocks
- ___ i. Crosscut saw
- ___ j. Corner poles

4. List two items that are masonry power equipment below.

a.

b.

5. Demonstrate the ability to:

- a. Identify masonry hand tools.
- b. Identify masonry equipment and power equipment.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT I
MASONRY TOOLS AND EQUIPMENT

ANSWERS TO UNIT TEST

1. 5 a.
 4 b.
 2 c.
 1 d.
 3 e.
 6 f.

2. a. laying
 b. laying
 c. laying
 d. laying
 e. finishing
 f. finishing
 g. laying
 h. laying
 i. finishing
 j. laying
 k. finishing
 l. finishing

3. ✓ a.
 ✓ b.
 ✓ c.
 d.
 ✓ e.
 ✓ f.
 ✓ g.
 ✓ h.
 i.
 ✓ j.

4. a. Mortar mixer
 b. Masonry saw

5. (a-b). Evaluated to the satisfaction of the instructor.

UNIT II
MASONRY SAFETY

UNIT OBJECTIVE

After completing this unit, the student will use safe practices while working in masonry and bricklaying. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit the student will be able to:

1. Match terms and definitions associated with masonry safety.
2. Identify the rules of masonry hand tool safety.
3. Identify the correct rules of equipment safety.
4. List four items of personal safety equipment.
5. Point out the rules of power equipment safety.
6. Demonstrate the ability to:
 - a. Prepare a masonry safety poster.
 - b. Inspect masonry tools and equipment.

UNIT II
MASONRY SAFETY

SUGGESTED ACTIVITIES

I. Instructor:

- A. Discuss unit objectives.
- B. Provide students with information and assignment sheets.
- C. Prepare transparencies and lesson plan.
- D. Discuss information and assignment sheets.
- E. Order and show films and posters on masonry safety.
- F. Prepare tool and equipment display.
- G. Give test.
- H. Review problem areas identified by test.

II. Student:

- A. Discuss questions of unit objective.
- B. Read and discuss information and assignment sheets.
- C. Complete assignment sheets.
- D. Take unit test.
- E. Discuss test questions missed.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
 - 1. II-TM-1--Hardened Steel Can Shatter
 - 2. II-TM-2--Keep Hand Tools In Place

3. II-TM-3--Be Careful On Scaffolds
4. II-TM-4--Be Careful When Using Masonry Saw
5. II-TM-5--Don't Put Objects In Turning Mixers
6. II-TM-6--Clean Up Spilled Gasoline

D. Assignment sheets

1. Assignment Sheet #1--Prepare Masonry Safety Poster
2. Assignment Sheet #2--Inspect Masonry Tools and Equipment

E. Unit test

F. Answers to unit test

II. References:

- A. Dalzell, Ralph J. and Gilbert Townsend. Masonry Simplified, Vol. I. Chicago, Illinois: American Technical Society, 1956.
- B. Bricklaying I. Brick Institute of America. Albany, New York: Delmar Publishers, Inc., 1951.

UNIT II

MASONRY SAFETY

INFORMATION SHEET

I. Terms and definitions

- A. Caustic--Any material that can cause burns by chemical reaction, such as an acid
- B. Lime--A caustic material used in making mortar mix
- C. Mortar mix--A material containing lime and used for bonding brick or stone

(NOTE: The caustic content of mortar mix can cause allergic reactions in some people.)
- D. Muriatic acid--An acid combined with water and used to remove mortar from masonry

(NOTE: Use rubber gloves when handling acids.)

II. Masonry hand tool safety

- A. Beware of sharp edges on hand tools such as trowels
- B. Brick hammers are made of hardened steel and can shatter if struck too hard (Transparency #1)
- C. Do not strike tools with hardened surfaces against other hardened surfaces
- D. Keep all hand tools in their proper place (Transparency #2)
- E. Be careful not to drop tools from scaffolds

III. Equipment safety

- A. Mortar stand
 - 1. Should be placed within easy reach of the mason
 - 2. Should be set up level and steady
- B. Scaffolds (Transparency #3)

1. Should be strong enough to safely hold the worker, mortar, and bricks
2. Secure scaffolds to prevent tipping over
3. Load scaffolds correctly to prevent overload on an edge or end

C. Wheelbarrow

1. Used to move heavy loads to prevent strain
2. Do not over fill

IV. Personal safety equipment

- A. Hard hat--Should be worn when doing masonry work
- B. Steel-toed shoes--Protect feet from injury by dropped objects
- C. Safety glasses--Should be worn when using a masonry saw
- D. Rubber gloves--Protect hands from acid burns

V. Power equipment safety (Transparency #4)

A. Masonry saw

1. Always wear eye protection.
2. Keep hands away from blade while power is connected.
3. Check electric cord for frayed or bare wires.

B. Electric mortar mixer (Transparency #5)

1. Never place hands in a turning mixer.
2. Do not put shovel or other objects in a turning mixer.
3. Check electric cord for frayed or bare wires.
4. Stay clear of pulleys, belts and gears.

C. Gasoline-powered mixer (Transparency #6)

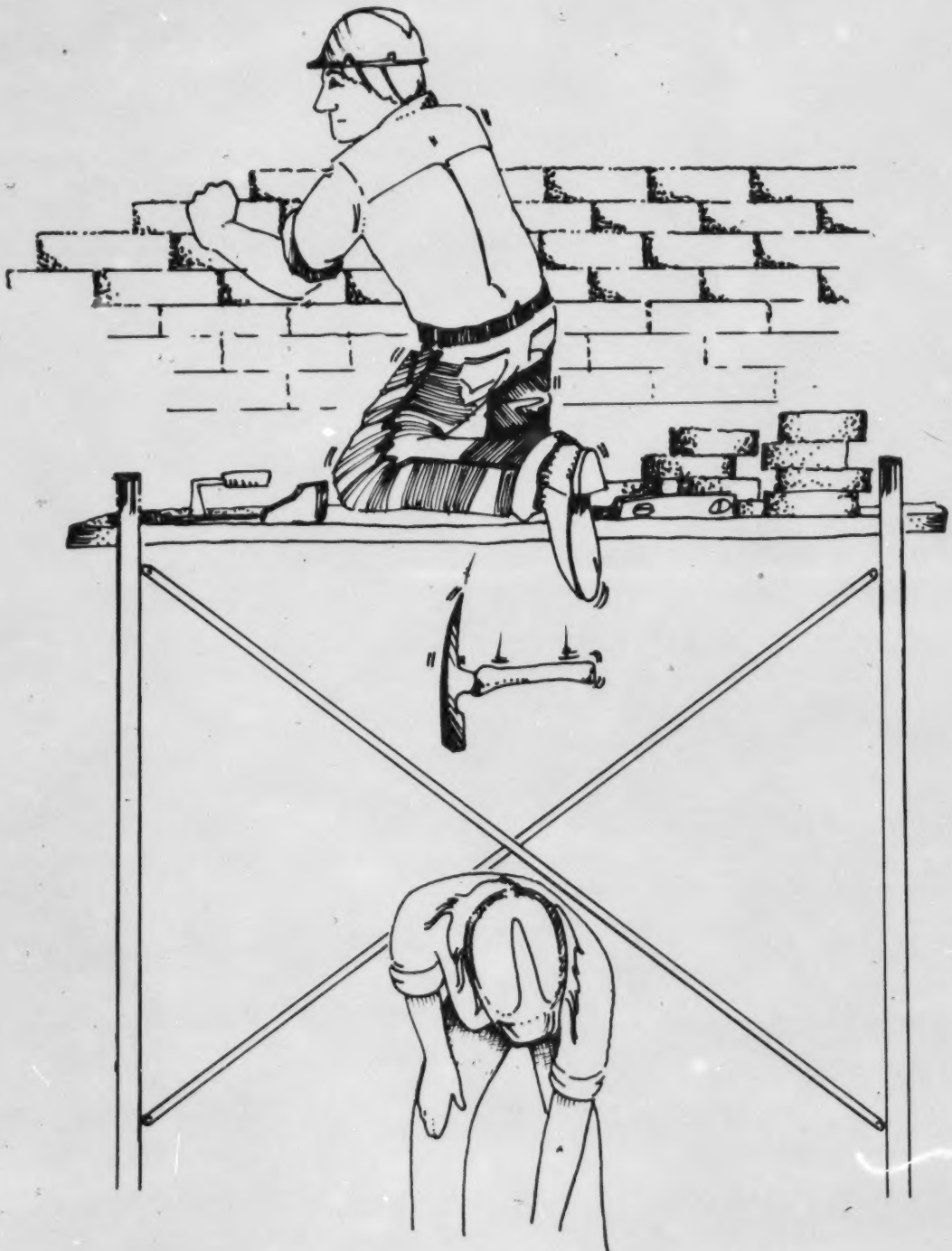
1. Fill gas tank in open area.
2. Do not start if gas is spilled on engine.

3. Move gas can away from mixer before starting.
4. Do not put hand or other objects in mixer while it is turning.
5. Stay clear of pulleys, belts and gears.

HARDENED STEEL CAN SHATTER



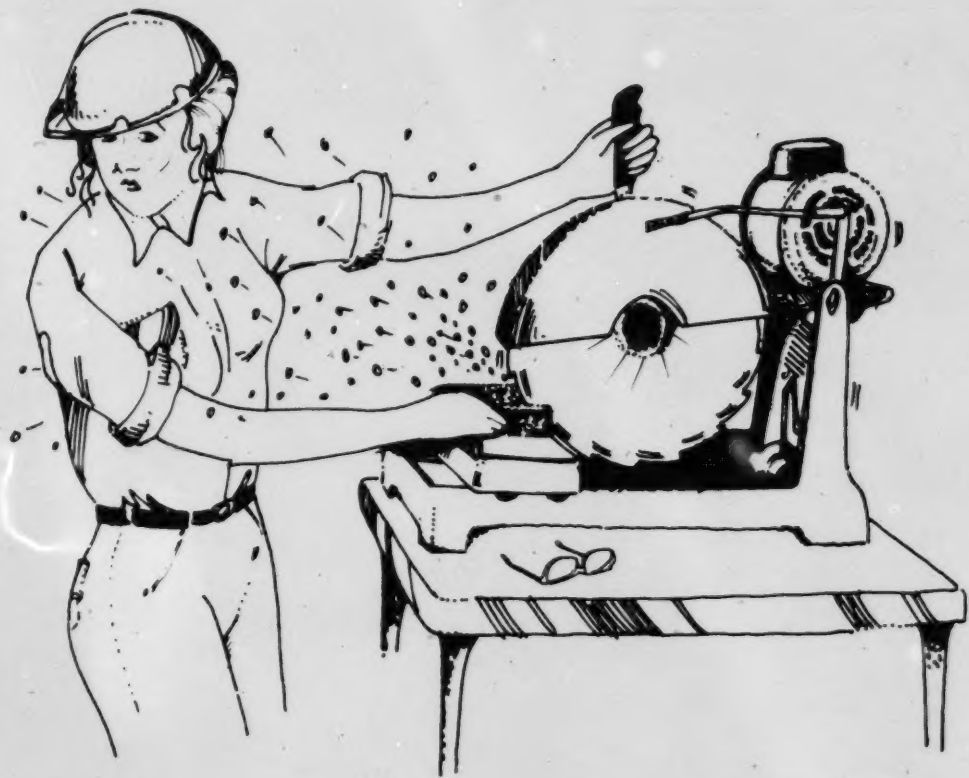
KEEP HAND TOOLS IN PLACE



BE CAREFUL ON SCAFFOLDS



BE CAREFUL WHEN USING MASONRY SAW



DON'T PUT OBJECTS IN TURNING MIXER



CLEAN UP SPILLED GASOLINE



UNIT II

MASONRY SAFETY

ASSIGNMENT SHEET #1--PREPARE MASONRY SAFETY POSTER

Directions: On a piece of poster board or sheet of typing paper, prepare a poster about masonry safety. You may want to use some of the safety rules covered in the Information Sheet for ideas in making your poster. (NOTE: The instructor may want to display your poster as a safety reminder.)

UNIT II
MASONRY SAFETY

ASSIGNMENT SHEET #2--INSPECT MASONRY TOOLS
AND EQUIPMENT

Directions: The instructor will display the masonry tools and equipment used in this class. You are to inspect each tool and piece of equipment. On a piece of paper, write any unsafe condition you find. When you have finished your inspection, give your list to the instructor.

The following items are some areas you may want to check.

1. Chipped hammers
2. Mushroomed-headed chisels
3. Broken handles
4. Sharp edges or burrs on trowels
5. Frayed power cords
6. Worn belts on mixer

UNIT II
MASONRY SAFETY

UNIT TEST

1. Match the masonry safety terms in the right hand column to the correct definition on the left by placing the number in the blank.

- | | |
|---|------------------|
| ___ a. An acid combined with water and used to remove mortar from masonry. | 1. Mortar mix |
| ___ b. A caustic material used in making mortar mix | 2. Caustic |
| ___ c. A material containing lime and used for bonding brick or stone | 3. Lime |
| ___ d. Any material that can cause burns by chemical reaction such as an acid | 4. Muriatic acid |

2. Identify the correct rules of masonry hand tool safety by placing a "✓" in the blank beside the correct rules only.

- ___ a. Beware of sharp edges on hand tools such as trowels.
- ___ b. Brick hammers are made of hardened steel and can shatter.
- ___ c. Keep all hand tools in their proper place.
- ___ d. A hammer with a broken handle is not dangerous.

3. Identify the correct rules of equipment safety by placing a "✓" in the blank beside the correct rules only.

- ___ a. Mortar stands should be placed within easy reach of the mason.
- ___ b. Scaffolds should be strong enough to safely hold the worker, mortar, and bricks.
- ___ c. Do not secure scaffolds to prevent them from tipping over.
- ___ d. Use a wheelbarrow to move heavy loads.

4. List four items of personal safety equipment that are worn when doing masonry work.
 - a.
 - b.
 - c.
 - d.
5. Point out the correct rules of power equipment safety by placing a "✓" in the blank beside the correct rules only.
 - ___ a. Always wear eye protection when using the masonry saw.
 - ___ b. Keep hands away from masonry saw blade while power is connected.
 - ___ c. Add materials to mortar mixer while it is turning.
 - ___ d. Move the gas can away from gas powered mixer before starting.
6. Demonstrate the ability to:
 - a. Prepare a masonry safety poster.
 - b. Inspect masonry tools and equipment.

(NOTE: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT II
MASONRY SAFETY

ANSWERS TO UNIT TEST

1. 4 a.
3 b.
1 c.
2 d.
2. ✓ a.
✓ b.
✓ c.
 d.
3. ✓ a.
✓ b.
 c.
✓ d.
4. a. Hard hat
b. Steel-toed shoes
c. Safety glasses
d. Rubber gloves
5. ✓ a.
✓ b.
 c.
✓ d.
6. (a-b) Evaluated to the satisfaction of the instructor.

UNIT III
MASONRY MATERIALS

UNIT OBJECTIVE

After completing this unit, the student will be able to identify masonry materials. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVE

After completion of this unit, the student will be able to:

1. Match the terms and definitions associated with masonry material
2. List three types of brick used in masonry work
3. Identify concrete blocks
4. List three kinds of stone used in masonry work
5. Demonstrate the ability to:
 - a. Identify masonry materials
 - b. Survey masonry materials

UNIT III

MASONRY MATERIALS

SUGGESTED ACTIVITIES

I. Instructor

- A. Discuss unit objectives
- B. Provide students with information and assignment sheets
- C. Prepare transparencies and lesson plans
- D. Prepare display of masonry materials covered in information sheet
- E. Plan a field trip to masonry materials manufacturer
- F. Give test
- G. Review problem areas identified by test

II. Student

- A. Discuss questions of unit objectives
- B. Read and discuss information and assignment sheets
- C. Complete assignment sheets
- D. Take test
- E. Discuss questions missed on test

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters

1. III-TM-1--Modular Brick Shapes
2. III-TM-2--Modular Brick Sizes
3. III-TM-3--Types of Concrete Blocks
4. III-TM-4--Designer Core Blocks

D. Assignment sheets

1. Assignment Sheet #1--Identify Masonry Materials
2. Assignment Sheet #2--Survey of Masonry Materials

E. Unit test

F. Answers to unit test

II. References:

- A. Kicklighter, Clois E. Modern Masonry. South Holland, Illinois: Goodheart-Wilcox Co., Inc. 1977.
- B. Krek, Sr., R. T. Masonry Skills. Albany, New York: Delmar Publishers, 1976.
- C. Dalzell, Ralph J., and Gilbert Townsend. Masonry Simplified. Chicago, Illinois: American Technical Society, 1970.

UNIT III
MASONRY MATERIALS
INFORMATION SHEET

I. Terms and definitions

- A. Kiln--A large oven used to burn or "fire" bricks
- B. Brick--A masonry unit made of clay or shale and fired in a kiln
- C. Concrete block--A solid or hollow masonry unit made of concrete
- D. Nominal--The actual size of a brick plus the thickness of the mortar joint
- E. Modular--Brick sizes that make estimating the number of bricks needed easier
- F. Ceramic--A high gloss finish that is baked on in a kiln

II. Bricks

A. Types

- 1. Face brick--Used for good appearance where a wall will be seen
- 2. Common brick--Used where strength is needed
(Note: Common brick is also called building brick.)
- 3. Fire brick--Used in places exposed to high heat, such as fireplaces

B. Sizes and shapes (Transparency #1 and #2)

- 1. Thickness varies from about 3 to 12 inches
- 2. Height varies from about 2 to 8 inches
- 3. Length can be up to 16 inches
- 4. Most bricks are modular sized

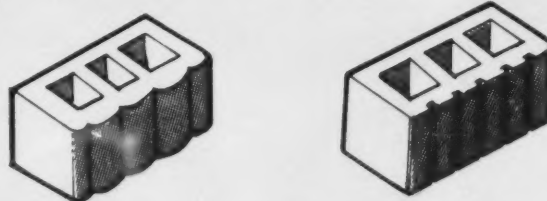
C. Colors

1. Range from white to yellow in the light colors
2. Range from tan to dark red in the dark colors
3. Mineral additives are used to change colors before the brick is fired

III. Concrete blocks

A. Types (Transparency #3)

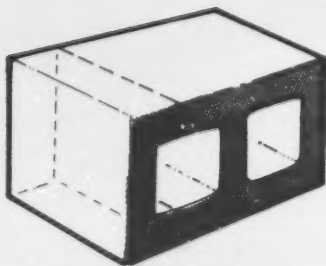
1. Standard lightweight--Used for flat surface walls
2. Textured--Design blocks used for decorative walls



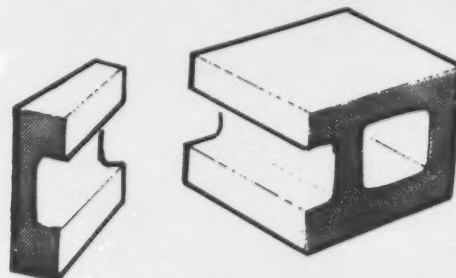
3. Glazed face--Has ceramic surface that resists water and chemicals
4. Designer core--Used for decorative walls that control noise and light (Transparency #4)

B. Classes of blocks

1. Solid load-bearing
 - a. Used to support heavy loads, such as roof structures
 - b. Not more than 25% of cross-sectional area in hollow



CROSS-SECTION CUT



LESS THAN 25% IS HOLLOW

2. Hollow load-bearing

- a. Used to support most common building loads
- b. 40 to 50% of cross-sectional area is hollow

3. Hollow non-load-bearing

- a. Thin-shelled and lightweight
- b. Used in non-load bearing walls

C. Sizes

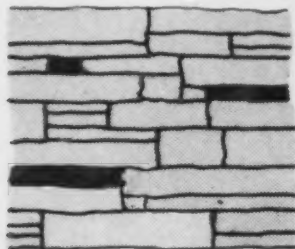
BLOCK	MANUFACTURED SIZE			JOINT SIZE	NOMINAL SIZE		
	t	h	l		t	h	l
12 in.	7 5/8	7 5/8	11 5/8	3/8	8	8	12
16 in.	7 5/8	7 5/8	15 5/8	3/8	8	8	16

(NOTE: Thickness can vary from 4 to 12 inches.)

IV. Stone

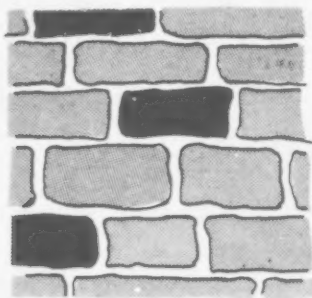
A. Flagstone

- 1. Large, flat rock
- 2. Generally 3 to 4 inches thick
- 3. Laid on edge



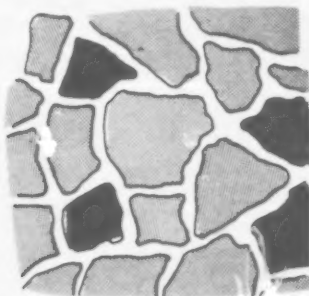
B. Cut stone

1. Large, flat rock
2. Cut to 3 to 4 inches wide
3. Laid with edges exposed

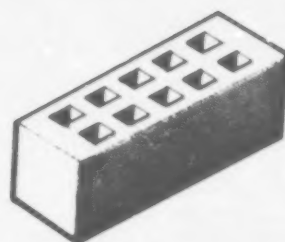
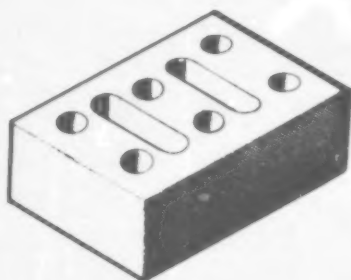
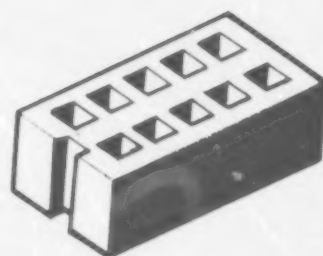
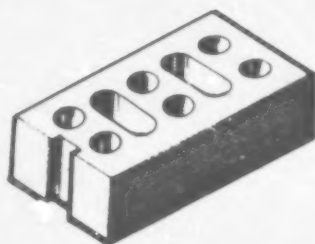


C. Rubble stone

1. Large and irregular in shape
2. Used to build thick, strong walls



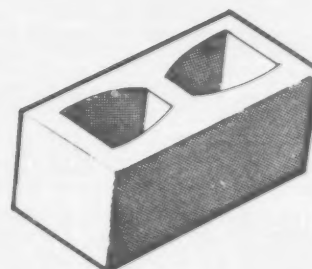
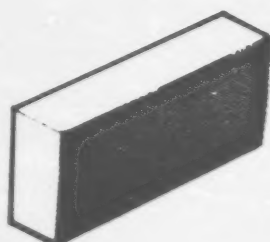
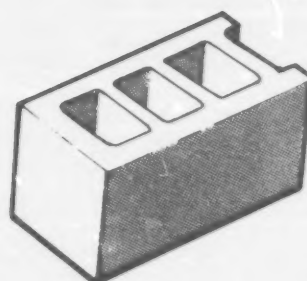
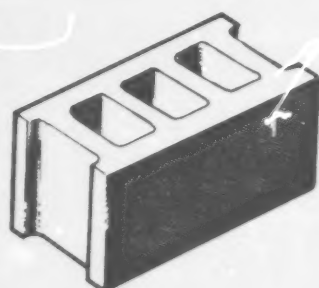
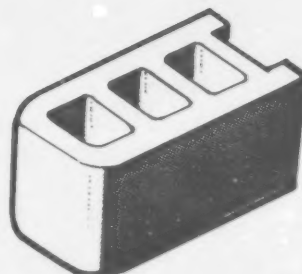
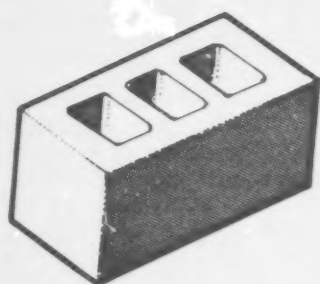
MODULAR BRICK SHAPES



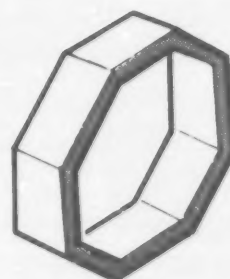
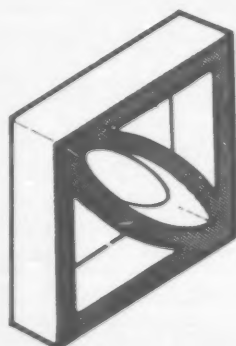
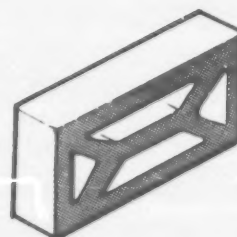
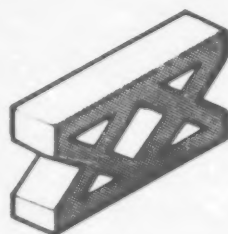
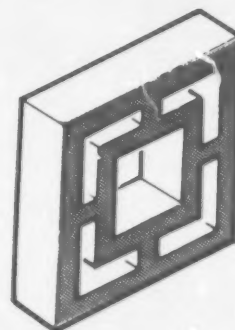
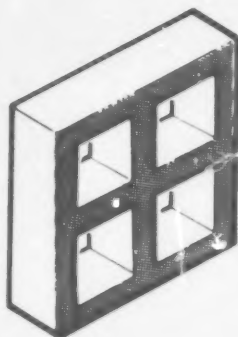
MODULAR BRICK SIZES

UNIT DESIGNATION	NOMINAL DIMENSIONS, IN.			JOINT THICKNESS IN.	MANUFACTURED DIMENSIONS IN.		
	t	h	l		t	h	l
STANDARD MODULAR	4	2 2/3	8	3/8	3 5/8	2 1/4	7 5/8
				1/2	3 1/2	2 1/4	7 1/2
ENGINEER	4	3 1/5	8	3/8	3 5/8	2 13/16	7 5/8
				1/2	3 1/2	2 11/16	7 1/2
JUMBO	4	4	8	3/8	3 5/8	3 5/8	7 5/8
				1/2	3 1/2	3 1/2	7 1/2
DOUBLE	4	5 1/3	8	3/8	3 5/8	4 15/16	7 5/8
				1/2	3 1/2	4 13/16	7 1/2
ROMAN	4	2	12	3/8	3 5/8	1 5/8	11 5/8
				1/2	3 1/2	1 1/2	11 1/2
NORMAN	4	2 2/3	12	3/8	3 5/8	2 1/4	11 5/8
				1/2	3 1/2	2 1/4	11 1/2
NORWEGIAN	4	3 1/5	12	3/8	3 5/8	2 13/16	11 5/8
				1/2	3 1/2	2 11/16	11 1/2
TRIPLE	4	5 1/3	12	3/8	3 5/8	4 15/16	11 5/8
				1/2	3 1/2	4 13/16	11 1/2
SCR BRICK	6	2 2/3	12	3/8	5 5/8	2 1/4	11 5/8
				1/2	5 1/2	2 1/4	11 1/2

TYPES OF CONCRETE BLOCKS



DESIGNER CORE BLOCKS



UNIT III
MASONRY MATERIALS

ASSIGNMENT SHEET #1--IDENTIFY MASONRY MATERIALS

Directions: The instructor will prepare a display of the materials listed in Parts II, III, and IV of the information sheet. Each item will be assigned a number only. On a sheet of paper, write the name of that item beside the number of that item.

(NOTE: The instructor may provide a list of masonry materials from which you can select your answer.)

UNIT III

MASONRY MATERIALS

ASSIGNMENT SHEET #2--SURVEY OF MASONRY MATERIALS

Directions: Survey the shop and classroom. On a sheet of paper, list all the different types of masonry materials you can identify. Try to determine in what class each material would be listed. Below is an example of how your list might appear.

Shop:	Exterior	Interior
North wall -	Common brick	Standard block Hollow-load bearing
East wall -	Common brick	Standard block Hollow-load bearing
South wall -	Standard block Non-load bearing	Standard block Non-load bearing
West wall -	Standard block Non-load-bearing	Standard block Non-load-bearing

UNIT III
MASONRY MATERIALS

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Evaluated to the satisfaction of the instructor.

Assignment Sheet #2

Evaluated to the satisfaction of the instructor.

UNIT III
MASONRY MATERIALS

UNIT TEST

1. Match the masonry terms in the right hand column to the correct definition of the left. Place the number in the blank.

_____ a. The actual size of a brick plus the thickness of the mortar joint	1. Ceramic
_____ b. A large oven used to burn or "fire" bricks	2. Brick
_____ c. A solid or hollow masonry unit made of concrete	3. Kiln
_____ d. A high gloss finish that is baked on in a kiln	4. Nominal
_____ e. A masonry unit made of clay or shale and fired in a kiln	5. Modular
_____ f. Brick sizes that make estimating the number of bricks needed easier	6. Concrete block

2. List three types of bricks used in masonry work

- a.
- b.
- c.

3. Identify the true statements below about concrete blocks. Place a "✓" in the blank.

- _____ a. Designer core blocks are used for decorative walls and to control noise and light.
- _____ b. Glazed face blocks have ceramic surfaces that resist water and chemicals.
- _____ c. Solid load-bearing blocks are not more than 40% hollow in a cross-sectional area.

_____ d. Hollow non-load-bearing blocks are thin and lightweight.

_____ e. Thickness of concrete block can vary from 4 to 12 inches.

4. List three kinds of stone used in masonry work.

a.

b.

c.

5. Demonstrate the ability to:

a. Identify masonry materials

b. Survey masonry materials

(NOTE: If these activities have not been completed prior to the test, ask your instructor when they should be completed.)

UNIT III
MASONRY MATERIALS

ANSWERS TO UNIT TEST

1. 4 a.
 3 b.
 6 c.
 1 d.
 2 e.
 5 f.
2. a. face
 b. common
 c. fire
3. ✓ a.
 ✓ b.
 c.
 ✓ d.
 ✓ e.
4. a. Flagstone
 b. Cut stone
 c. Rubble stone
5. a. Evaluated to the satisfaction of the instructor.
 b. Evaluated to the satisfaction of the instructor.

UNIT IV
MORTAR PREPARATION AND APPLICATION

UNIT OBJECTIVE

After completing this unit, the student will be able to prepare and apply mortar. This knowledge will be evidenced through demonstration and by satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match the terms and definitions associated with masonry mortar
2. Identify the correct types of mortar mix
3. List three qualities of mortar sand
4. Identify correct statements about water used to make mortar
5. Select the correct formulas for mixing mortar
6. Identify the proper methods for mixing mortar
7. Determine the correct rules in caring for mixed mortar
8. Demonstrate the ability to:
 - a. Mix mortar by hand
 - b. Mix mortar, using a power mixer
 - c. Supply a mortar stand with mortar
 - d. Spread mortar

UNIT IV
MORTAR PREPARATION AND APPLICATION

SUGGESTED ACTIVITIES

I. Instructor

- A. Discuss unit objectives
- B. Provide student with information and job sheets
- C. Prepare transparencies and lesson plans
- D. Give demonstration of mixer operation
- E. Give test
- F. Review problem areas identified by test

II. Student

- A. Discuss questions of unit objectives
- B. Read and discuss information and job sheets
- C. Complete job sheets
- D. Take test
- E. Discuss questions missed on test

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
 - 1. IV-TM-1--Above Grade - Below Grade
 - 2. IV-TM-2--Methods of Mixing Mortar
- D. Job sheets
 - 1. Job Sheet #1--Mix Mortar By Hand
 - 2. Job Sheet #2--Mix Mortar Using a Power Mixer

3. Job Sheet #3--Supply a Mortar Stand With Mortar

4. Job Sheet #4--Spread Mortar

E. Unit test

F. Answers to unit test

II. References:

- A. Kicklighter, Clois E. Modern Masonry. South Holland, Illinois: Goodheart-Wilcox Co., Inc., 1977.
- B. Krek, Sr., R. T. Masonry Skills. Albany, New York: Delmar Publishers, 1976.
- C. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1976.

UNIT IV
MORTAR PREPARATION AND APPLICATION

INFORMATION SHEET

I. Terms and definitions

- A. Mortar--A mixture of portland cement, lime, sand, and water used for bonding brick
- B. Caustic--Any material that can cause burns by chemical reaction, such as acid
- C. Lime--A caustic material used in making mortar mix
- D. Masonry cement--Pre-mixed portland cement and lime used in making mortar
- E. Plastic mortar--Mortar that has just been mixed
- F. Slump--The settling action of plastic mortar
- G. Above grade--Above the level of the ground
- H. Below grade--Below the level of the ground
- I. Pre-mix--Two or more ingredients mixed and packaged by the manufacturer
- J. Bond--To hold together
- K. Compress--To push together
- L. Consistency--How firm or watery the mortar is

II. Types of mortar mix

- A. Pre-mixed
 - 1. Consists of portland cement and lime in correct ratio
 - 2. Needs only sand and water added to become mortar
- B. On-the-job
 - 1. Type M
 - a. Has high compressive strength
 - b. Used for exterior and below grade work

2. Type S
 - a. Has high bonding strength
 - b. Used for exterior and below grade work
3. Type N
 - a. Used for general purpose
 - b. Highly weather resistant
 - c. For above-grade use, only
4. Type O
 - a. Has low strength
 - b. Used for interior work only
5. Type K
 - a. Has very low strength
 - b. Used for interior work only
 - c. Will not support a load

III. Qualities of sand

A. Cleanliness

1. Should be free of trash, dirt, and rocks
2. Will not bond if dirty

B. Sharpness

1. Must be sharp-edged to bond
2. Will slump and not bond if round

C. Sized

MAGNIFIED VIEW OF SAND

1. Should have different sizes of sand mixed together
2. Small sizes fill in between larger sizes



IV. Water

- A. Must be clean
- B. Will make weak mortar if dirty

V. Mortar mix formulas

- A. Pre-mixed
 - 1. One part mortar mix,
 - 2. Three parts sand, and
 - 3. Water
- B. On-the-job mix

PARTS BY VOLUME			
TYPE	PORTLAND CEMENT	HYDRATED LIME	SAND
M	1	1/4	2 1/2 to 3 times the total amount of cement and lime
S	1	1/4 to 1/2	
N	1	1/2 to 1 1/4	
O	1	1 1/4 to 1 1/2	
K	1	2 1/2 to 4	

VI. Methods of mixing

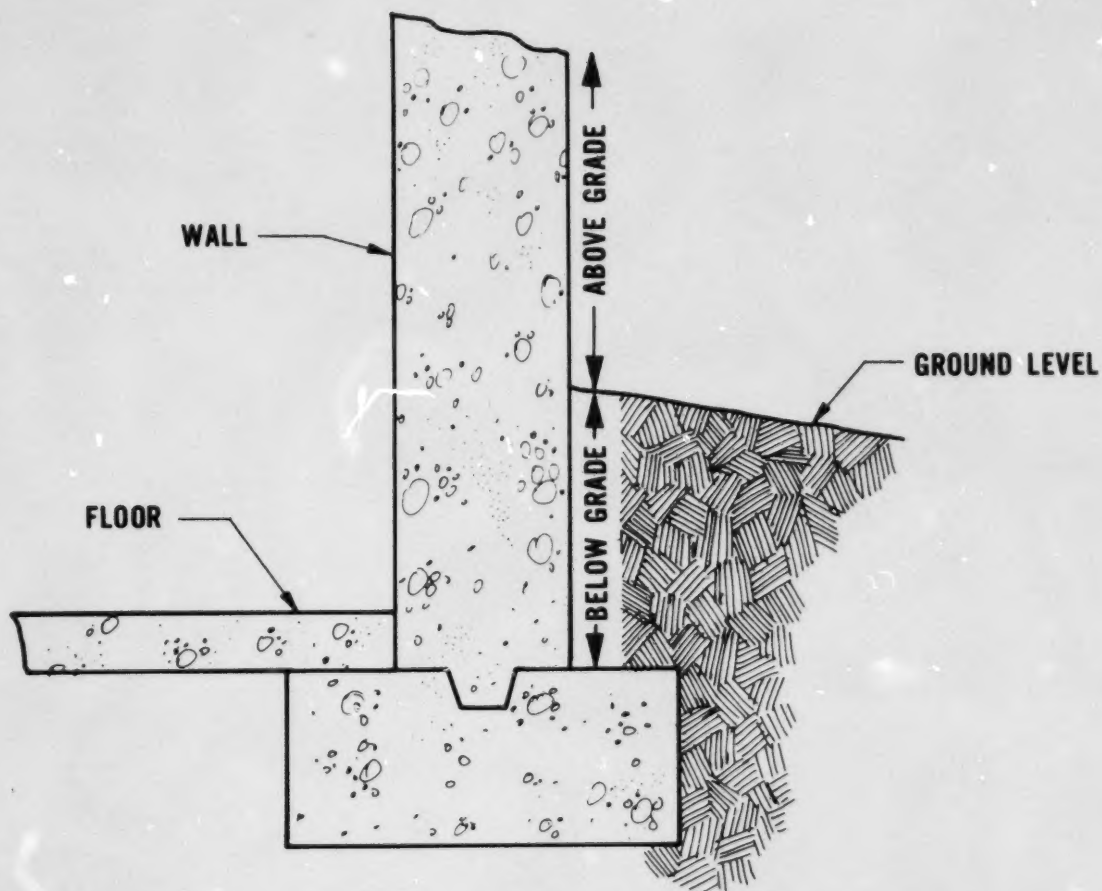
- A. Using power mixer
 - 1. Follow the table for correct amounts of each mortar part
 - 2. Follow proper procedure for adding and mixing mortar parts
 - 3. Do not put shovel in mixer while mixer is turning
- B. Hand mixing
 - 1. Follow the table for correct amounts of each mortar part

2. Follow proper procedures for adding and mixing mortar parts
3. Do not overfill mortar box

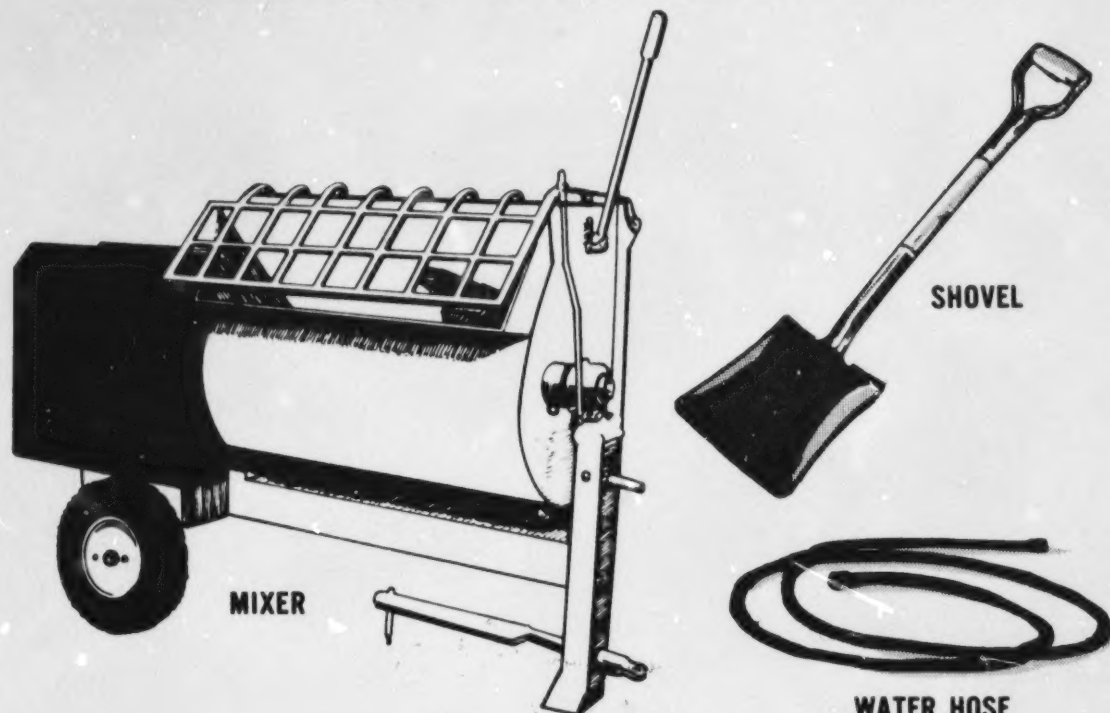
VII. Caring for mixed mortar

- A. Keep mortar in a tight pile
- B. Sprinkle lightly with water in very hot weather
- C. Re-mix every 5 to 10 minutes to keep proper consistency
- D. Add water only when really necessary
- E. Wet mortar boards to keep board from drawing water from mortar

ABOVE GRADE-BELOW GRADE



METHODS OF MIXING MORTAR



MIXER

SHOVEL

WATER HOSE

Power Mixing



WHEELBARROW

HOE

SHOVEL

MORTAR BOX

Hand Mixing

TM-2

UNIT IV

MORTAR PREPARATION AND APPLICATION

JOB SHEET #1--MIX MORTAR BY HAND

I. Tools and materials

- A. Mortar box
- B. Mortar hoe
- C. Shovel
- D. Mortar mix
- E. Sand
- F. Water

II. Procedures

- A. Determine correct amount of mortar mix, lime, and sand
- B. Place 1/2 of sand needed in a clean, dry mortar box
- C. Place mortar mix on the sand
- D. Place the remaining sand on top of the mortar mix
- E. Mix the sand and mortar well, using the mortar hoe
- F. Move all of the mixture to one end of the box, using the mortar hoe
- G. Add water to the empty end of the box
- H. Mix the dry mixture into the water
(Note: This mixing may be called "cut" because of the chopping action used.)
- I. Add water while mixing until mortar is the proper consistency
- J. Let mortar stand for 5 minutes
- K. Mix again

(Note: To test for proper consistency, drag the tip of the trowel through the mortar. The "V" formed by the trowel should not slump and the mortar surface should be smooth.)

- L. After mortar is mixed, ask instructor for further instructions
- M. Clean and store tools properly

UNIT IV
MORTAR PREPARATION AND APPLICATION

JOB SHEET #2--MIX MORTAR USING A POWER MIXER

- I. Tools and materials
 - A. Power mortar mixer
 - B. Shovel
 - C. Mortar mix
 - D. Sand
 - E. Water
- II. Procedures
 - A. Determine the correct amounts of mortar mix, lime, and sand
 - B. Pour small amount of water into the mixer
 - C. Start the mixer motor
 - D. Add 1/3 of sand needed
 - E. Slowly add all of the mortar mix
 - F. Add one or two shovels of sand and then a little more water
 - G. Continue step "F" until all of the correct amount of sand is in the mixer
 - H. Add water until mortar is of proper consistency
(Note: Instructor will want to check for consistency of mortar at this point.)
 - I. Dump mortar from mixer
 - J. Ask instructor about mortar use
 - K. Clean tools and equipment
 - 1. Fill mixer 1/4 full of water
 - 2. Turn on mixer and run it until paddles are clean

3. Dump the water into proper container
 4. Rinse inside of mixer with water, using hoe
 5. Rinse mortar from all tools
 6. Store tools and equipment properly
- L. Wash your hands

UNIT IV

MORTAR PREPARATION AND APPLICATION

JOB SHEET #3--SUPPLY A MORTAR STAND WITH MORTAR

I. Tools and materials

- A. Wheelbarrow
- B. Mortar hoe
- C. Shovel
- D. Mortar
- E. Water in a bucket
- F. Mortar stand
- G. Trowel

II. Procedures

- A. Re-mix the mortar in box with mortar hoe
- B. Wet the inside of wheelbarrow and dump excess water
- C. Fill the wheelbarrow 3/4 full of mortar, using the shovel
- D. Push wheelbarrow to mortar stand location
- E. Wet the surface of the mortar stand
- F. Place 3 to 4 shovels of mortar onto the center of mortar stand
- G. Mound the mortar in the center of the stand using the trowel
- H. When mason uses mortar down to about 1 shovel, more mortar should be added to mortar board
- I. Mix fresh mortar with mortar still on the stand, using the trowel

(Note: Keep stand close to the mason but do not get in the way.)

J. When job is complete, clean and store tools and equipment properly

K. Wash your hands

UNIT IV
MORTAR PREPARATION AND APPLICATION

JOB SHEET #4--SPREAD MORTAR

I. Tools and materials

- A. Trowel
- B. Mortar stand
- C. Mortar
- D. Shovel
- E. Row of bricks

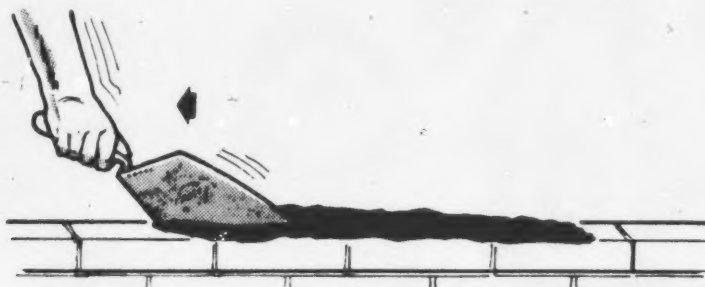
II. Procedures

- A. Set up mortar stand
- B. Place 3 to 4 shovels of mortar on stand
- C. Grasp trowel loosely in hand at base of handle
- D. Re-mix mortar on the stand
- E. Scoop up a trowel full of mortar

(Note: Mortar also is called "mud" in the masonry trade.)

- F. Place edge of trowel on top of brick row
- G. Dump mortar while dragging trowel along the brick row

(Note: Row of mortar on brick should be about 2 1/2 inches wide and 2 inches deep on the brick row.)



H. Drag tip of trowel through top of mortar row



I. Lay brick and press into place

J. Scrape excess mortar squeezed from bed with trowel

K. Spread mortar left on trowel on the end of the brick just laid

L. Repeat steps B through K until job is complete

M. Clean all tools and equipment thoroughly

N. Store tools and equipment properly

O. Wash your hands

UNIT IV
MORTAR PREPARATION AND APPLICATION

UNIT TEST

1. Match the masonry terms in the right hand column to the correct definition on the left by placing the number in the blank

- | | |
|---|-------------------|
| ___ a. Pre-mixed portland cement and lime used in making mortar | 1. Plastic mortar |
| ___ b. Mortar that has just been mixed | 2. Above grade |
| ___ c. Above the level of the ground | 3. Pre-mix |
| ___ d. Below the level of the ground | 4. Masonry cement |
| ___ e. Two or more ingredients mixed and packaged by the manufacturer | 5. Bond |
| ___ f. To hold together | 6. Below grade |
| ___ g. To push together | 7. Consistency |
| ___ h. How firm or watery the mortar is | 8. Compressive |
| ___ i. The settling action of plastic mortar | 9. Slump |

2. Identify the correct types of mortar mix below. Place a "✓" in the blank beside each of the correct types

- ___ a. Type M
___ b. Type S
___ c. Type E
___ d. Type O
___ e. Type N
___ f. Type K

3. List three qualities that sand used in mortar should have
 - a.
 - b.
 - c.
4. Identify the correct statements below about water used in mortar. Place a "/" in the blank beside the correct statements
 - ☐ a. Water used to make mortar must be clean
 - ☐ b. Dirty water will make weak mortar
5. Select the correct formula for each of the mortar mixes. Place a "/" in the blank beside the correct formulas below

When mixing:

- ☐ a. Pre-mix--Use 1 part mortar mix and 3 parts sand
 - ☐ b. Type M--Use 1 part portland cement and 1/4 part of hydrated lime
 - ☐ c. Type N--Use 1 part portland cement and 1/2 to 1 1/4 parts of hydrated lime
 - ☐ d. Type K--Use 1 part of portland cement and 2 1/2 to 4 parts of hydrated lime
6. Identify the proper methods of mixing mortar. Place a "/" in the blank beside the correct methods below
 - ☐ a. Follow the table for correct amounts of each mortar part
 - ☐ b. Add whatever amounts you feel the mortar needs
 - ☐ c. Follow proper procedures for adding and mixing mortar parts
 - ☐ d. Use at least 2 different shovels for adding sand and cement

7. Determine the correct rules in caring for mixed mortar. Place a "✓" in the blank beside the correct rules below
- ☐ a. Wet mortar board to keep board from drying mortar
 - ☐ b. Keep mortar in a tight pile
 - ☐ c. Do not re-mix mortar
 - ☐ d. Add water only when necessary

8. Demonstrate the ability to:

- a. Mix mortar by hand
- b. Mix mortar using a power mixer
- c. Supply a mortar stand with mortar
- d. Spread mortar

(Note: If these activities have not been accomplished prior to the test, ask the instructor when they should be completed.)

UNIT IV
MORTAR PREPARATION AND APPLICATION

ANSWERS TO UNIT TEST

1. 4 a.
1 b.
2 c.
6 d.
3 e.
5 f.
8 g.
7 h.
9 i.
2. ✓ a.
✓ b.
 c.
✓ d.
✓ e.
✓ f.
3. a. Cleanliness
b. Sharpness
c. Sized
4. ✓ a.
✓ b.
5. ✓ a.
✓ b.
✓ c.
✓ d.

6. ☒ a.

☐ b.

☒ c.

☐ d.

7. ☒ a.

☒ b.

☐ c.

☒ d.

8. Evaluated to the satisfaction of the instructor

UNIT V

MASONRY WALLS

UNIT OBJECTIVE

After completing this unit, the student will be able to build a masonry wall. This knowledge will be evidenced through demonstration and satisfactorily completing a unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match the terms and definitions associated with masonry walls.
2. List three types of masonry joints.
3. Select correct types of masonry joint finishes.
4. Identify brick positions.
5. Identify kinds of brick courses.
6. Identify brick bonds.
7. List two types of concrete block bonds.
8. Select correct statements about corner lead.
9. Select correct statements about masonry wall openings.
10. Demonstrate the ability to:
 - a. Lay a corner lead six courses high
 - b. Complete a wall between corner leads

UNIT V
MASONRY WALLS

SUGGESTED ACTIVITIES

I. Instructor:

- A. Discuss unit objectives
- B. Provide student with information and job sheet
- C. Prepare transparencies, overlays, and lesson plans
- D. Show film
- E. Demonstrate laying out a wall section
- F. Give test
- G. Review problem areas identified by test

II. Student:

- A. Discuss questions of unit objectives
- B. Read and discuss information and job sheets
- C. Complete job sheets
- D. Take unit test
- E. Discuss questions missed on unit test

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
 - 1. V-TM-1--Names of Brick Positions
 - 2. V-TM-2--Kinds of Brick Courses
 - 3. V-TM-3--Kinds of Brick Bonds
 - 4. V-TM-4--Typical Wall Section

5. V-TM-4A--(Overlay for V-TM-4)

D. Job Sheets

1. Job Sheet #1--Lay a Corner Lead Six Courses High
2. Job Sheet #2--Complete a Wall Between Corner Leads

E. Unit test

F. Answers to unit test

II. References:

- A. Kicklighter, Clois E. Modern Masonry. South Holland, Illinois: Goodheart-Wilcox Co. Inc., 1977.
- B. Kreh Sr., R. T. Masonry Skills. Albany, New York: Delmar Publishers, 1976.
- C. Putman, Robert. Bricklaying Skill and Practice. Chicago, Illinois: American Technical Society, 1974.
- D. Basic Bricklaying. Executive Director, Clay Products of The Southwest: Keene, Texas 76059. (16 mm., color, 12 minutes)

UNIT V
MASONRY WALLS

INFORMATION SHEET

I. Terms and definitions

- A. Wall ties--Metal strips used to hold a brick wall in place



- B. Lead--The first part that is built in a masonry wall
- C. Corner lead--Building the corners of masonry walls first
- D. Closure brick--The last brick laid in a course
- E. Course--A layer of bricks, blocks, or stones in a masonry wall
- F. Lintel--A support for courses above wall openings
- G. Freize board--A board that is used for trim along the top of the last course

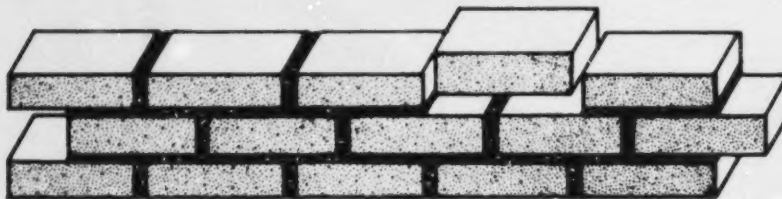
II. Types of masonry joints

- A. Bed joint--The horizontal mortar joint between each course

(NOTE: Do not lay more than 10 courses in a wall before mortar has begun to harden to prevent mortar from being pressed out of bottom joints.)

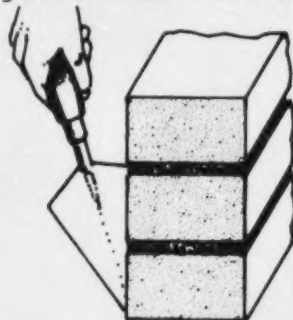
- B. Head joint--The vertical mortar joint between the ends of each brick or block
- C. Closure joint--The mortar joint between the last brick laid in a course

(NOTE: Check the last brick to be laid in a course for fit before applying mortar to closure joint.)



III. Types of masonry joint finishes

- A. Flush--Mortar is removed with edge of trowel leaving joint even with surface of brick



- B. Raked--Mortar is raked out of joint to a depth of $\frac{3}{8}$ inch using a wheel joint raker



- C. "V"-groove--Mortar is smoothed into joint with either an S-shaped or sled runner tool with "v"-shaped edge



- D. Concave--Mortar is smoothed into joint with either an S-shaped or sled runner tool with "U"-shaped edge



IV. Names of brick positions (Transparency #1)

- A. Stretcher
- B. Header
- C. Sailor
- D. Soldier
- E. Rowlock
- F. Rowlock stretcher

V. Kinds of brick courses (Transparency #2)

- A. Stretcher--The straight running courses in a wall
(NOTE: Stretcher courses are also called bond courses.)
- B. Soldier
 - 1. Brick stood on end to finish top of wall
 - 2. Allows for stretcher courses to be laid to the window openings
 - 3. Allows for top course to be laid to the freige board
- C. Header
 - 1. Courses that are turned crosswise in a double wall
 - 2. Tie double walls together every sixth course
 - 3. Used to cap the top of a double wall

D. Rowlock

1. Bricks are turned on edge
2. Used to cap double walls
3. Used to make window sills

VI. Kinds of brick bonds (Transparency #3)

A. American

(NOTE: Also known as running bond.)

B. Flemish

C. English

D. Stack

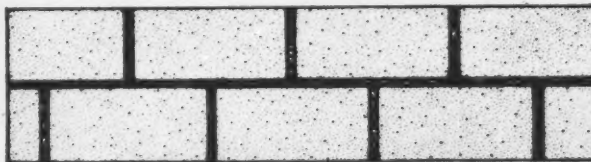
E. Common bond--Sixth course headers

VII. Concrete blocks

A. Joints--Same as for brick

B. Bonds

1. Straight--Should be laid with 1/2 overlap for maximum strength



2. Decorative

- a. Used for beauty
- b. Must be reinforced every second course



VIII. Corner lead (Transparency #4)

- A. First part laid in a masonry wall is usually the corners
- B. Corner pale is set in place and plumbed with courses marked
- C. Stretcher course is laid without mortar to check spacing
- D. Corners are mortared in place first
- E. Check for plumb and level as corner is laid

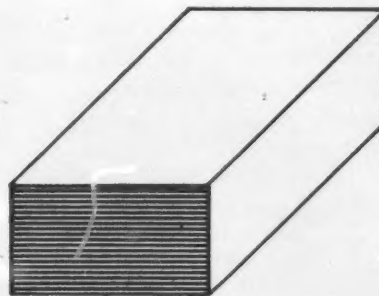
IX. Wall opening (Transparency #4A)

- A. Location of openings must be established
- B. Size and height of openings is determined
- C. Course spacing is adjusted to match wall openings
- D. Angle iron is used for lintels over wall openings

NAMES OF BRICK POSITIONS



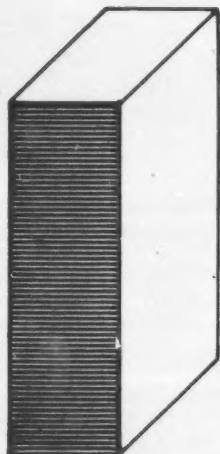
STRETCHER



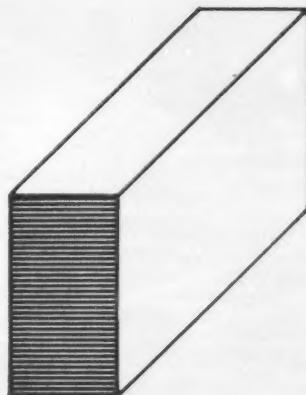
HEADER



SAILOR



SOLDIER

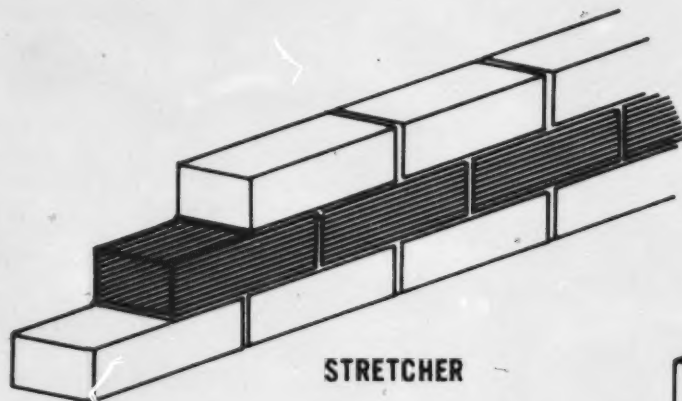


ROWLOCK

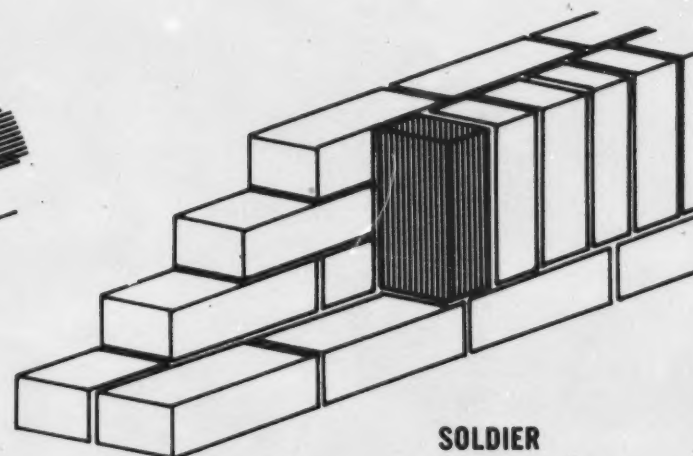


ROWLOCK STRETCHER

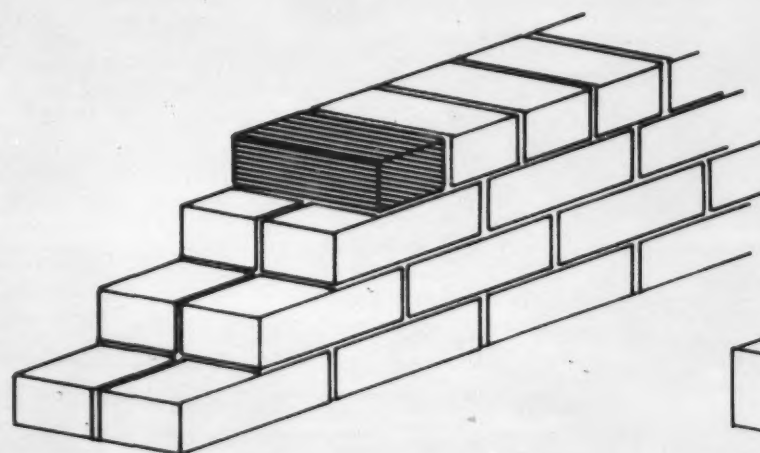
KINDS OF BRICK COURSES



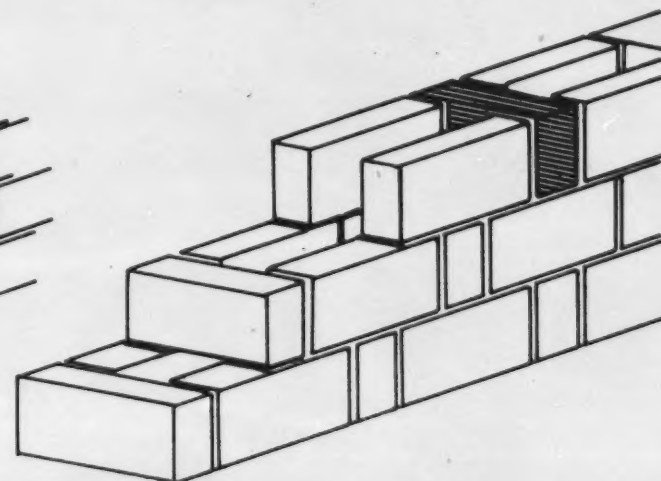
STRETCHER



SOLDIER

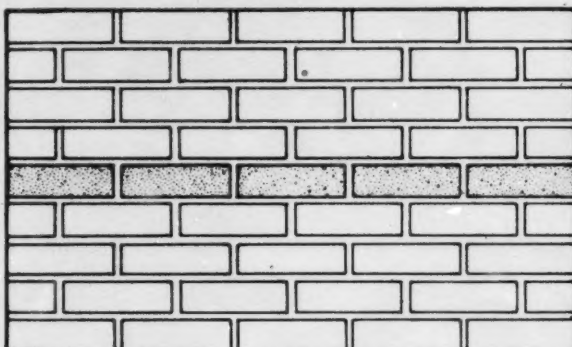


HEADER

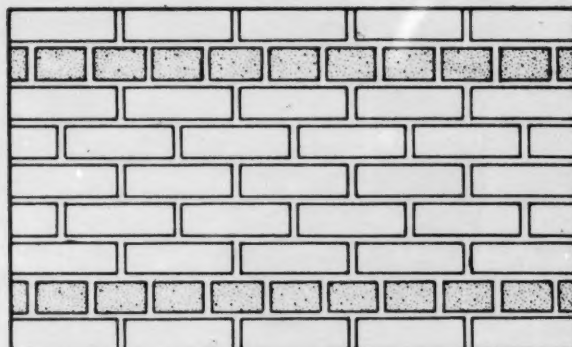


ROWLOCK

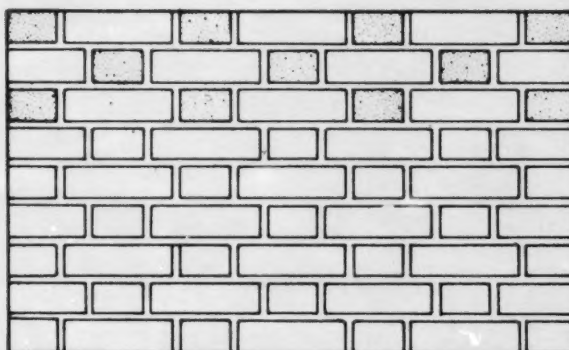
KINDS OF BRICK BONDS



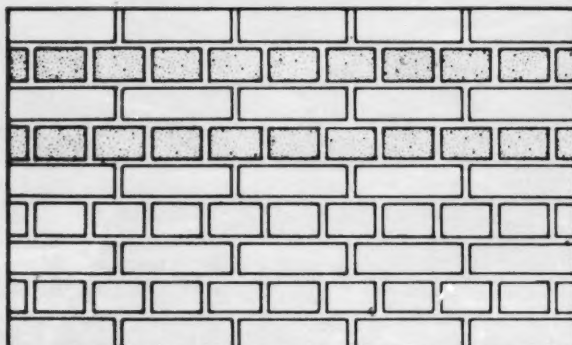
RUNNING BOND OR AMERICAN BOND



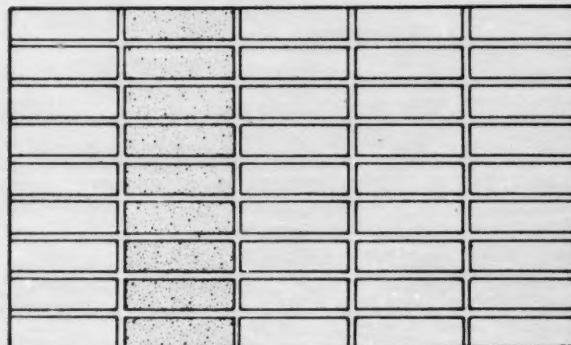
COMMON BOND - 6TH COURSE HEADERS



FLEMISH BOND

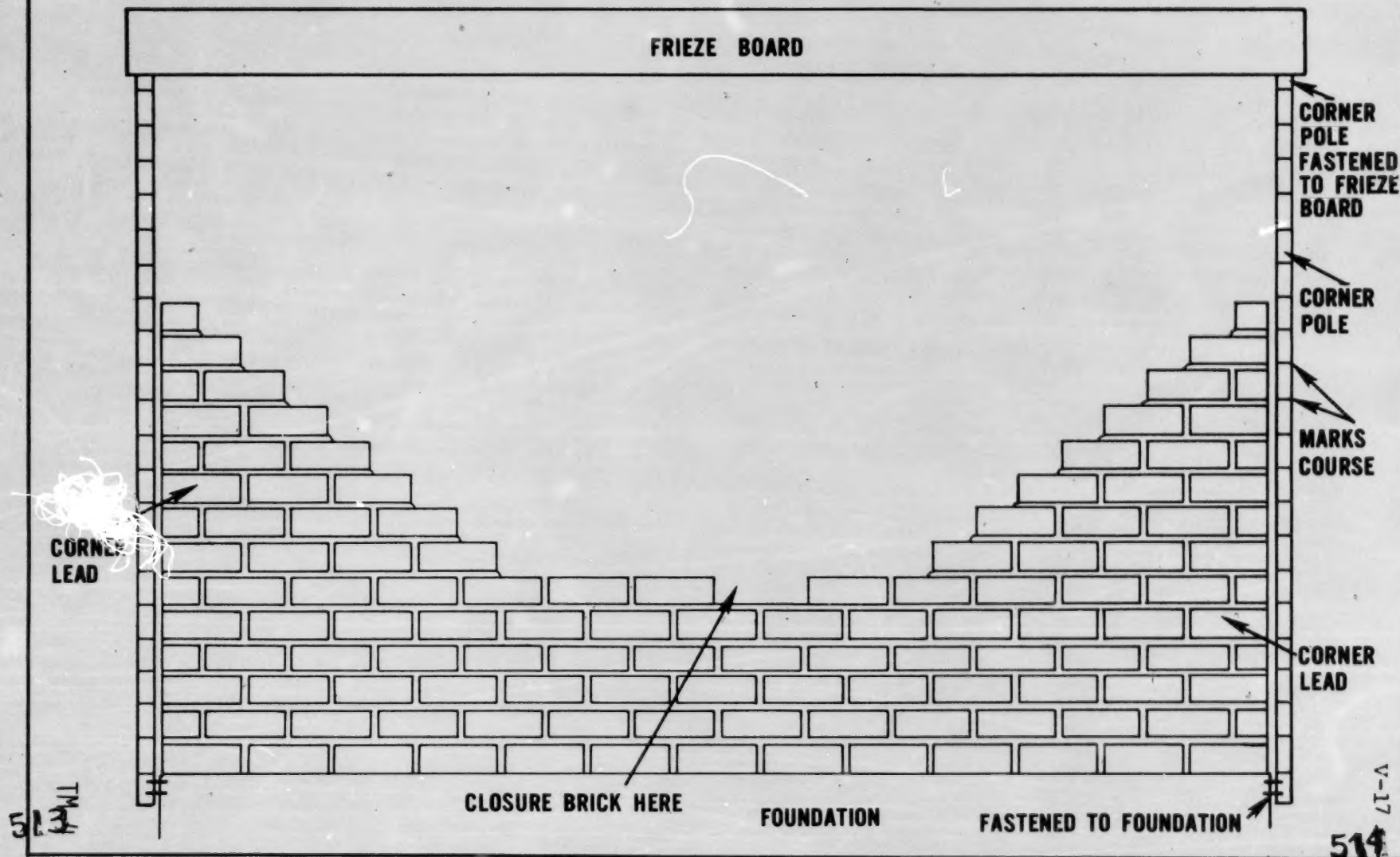


ENGLISH BOND



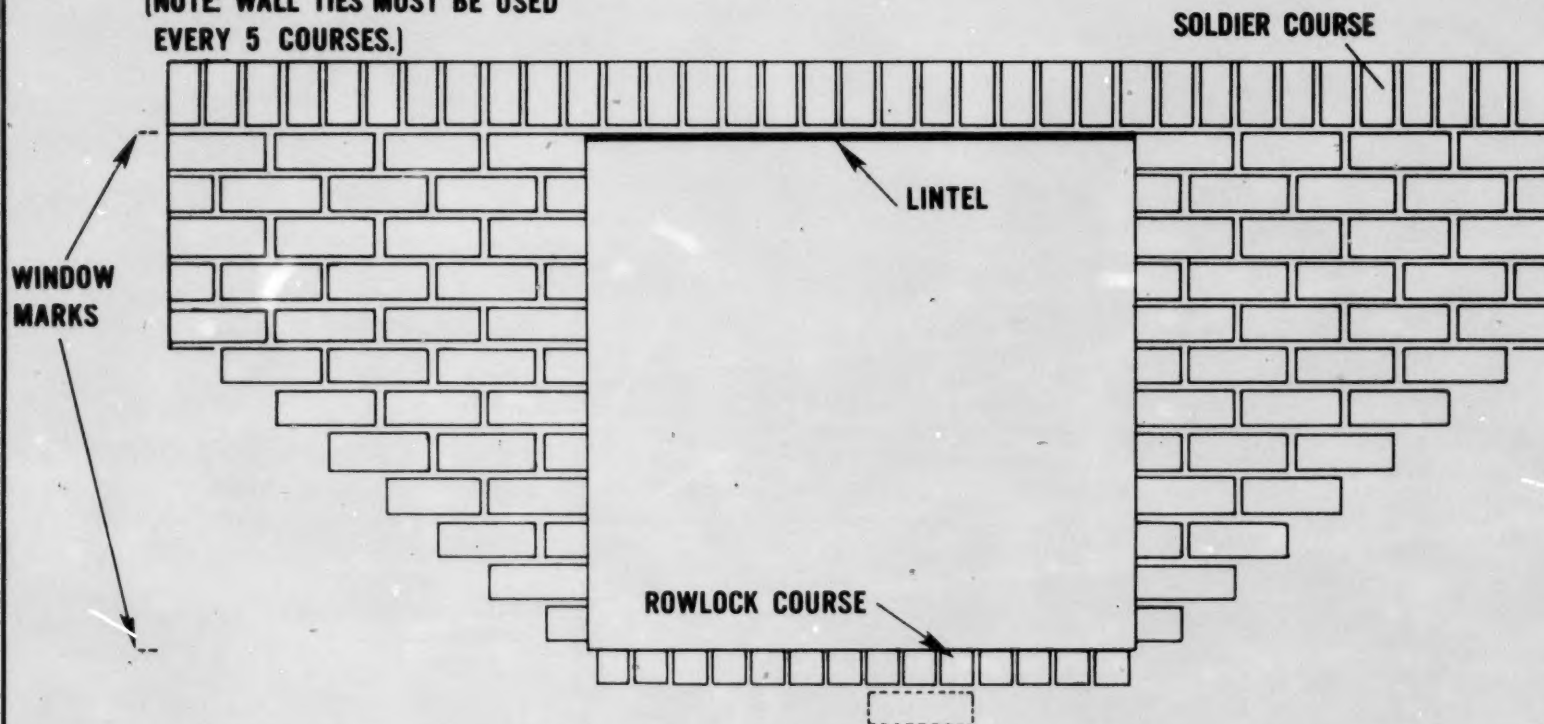
STACK BOND

TYPICAL WALL SECTION



WITH A WINDOW

(NOTE: WALL TIES MUST BE USED
EVERY 5 COURSES.)



CORNER
POLE

TM-4A

515

516

V-19

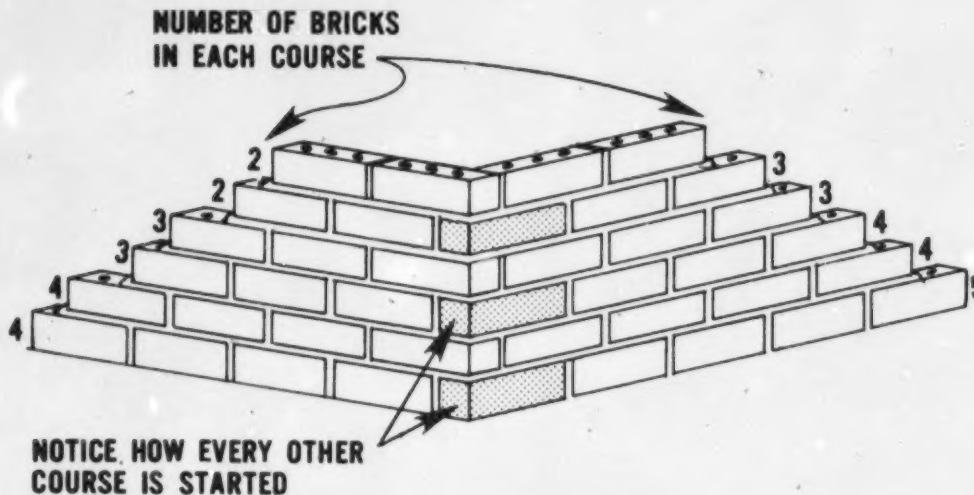
UNIT V

MASONRY WALLS

JOB SHEET #1--LAY A CORNER LEAD
SIX COURSES HIGH

- I. Tools and materials
 - A. Trowel
 - B. Mason level
 - C. Square
 - D. Masonry jointer
 - E. Broom
 - F. Mortar stand
 - G. Bricks
 - H. Mortar
- II. Procedures
 - A. Establish square corner lines for two corners
 - B. Lay first stretcher course without mortar to check spacing
 - C. Set up stand and fill with mortar
 - D. Lay mortar for bed joint
 - E. Start at the corner and lay a line of seven bricks in one direction
(NOTE: Be sure head joints are full of mortar.)
 - F. Start at first brick laid and lay seven bricks in the other direction
(NOTE: BE sure to keep line straight.)
 - G. Spread mortar on top of first course

- H. Start at corner and lay another course using drawing below for an example



- I. Repeat procedure until corners are six courses high
(NOTE: Be sure to check for plumb and level on each course.)
- J. Finish all joints with the mason's jointer
- K. Brush off any mortar that may have dropped on the bricks with the broom
- L. Clean and store tools and equipment properly
- M. Wash your hands

UNIT V
MASONRY WALLS

JOB SHEET #2--COMPLETE A WALL BETWEEN CORNER LEADS

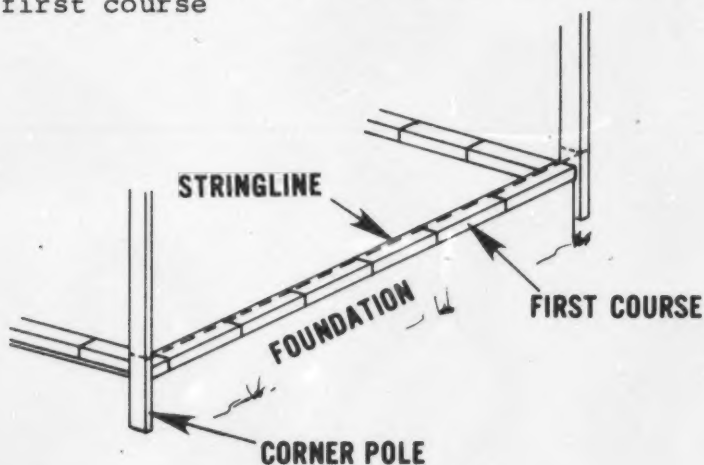
I. Tools and materials

- A. Trowel
- B. Mortar stand
- C. Masons line
- D. Corner poles
- E. Mason jointer
- F. Mortar
- G. Bricks

(NOTE: Corners built from Job Sheet #1 will be used.)

II. Procedures

- A. Attach corner poles to corner leads
- B. Plumb corner poles
- C. Attach masons line to corner poles and set for first course



UNIT V
MASONRY WALLS

UNIT TEST

1. Match the masonry terms in the right hand column to the correct definition on the left. Place the number in the blank.

_____ a.	Building the corners of masonry walls first	1. Closure brick
_____ b.	Metal strips used to hold a brick wall in place	2. Lintel
_____ c.	The last brick laid in a course	3. Wall ties
_____ d.	A board that is used for trim along the top of the last course	4. Freize board
_____ e.	A support for courses above wall openings	5. Course
_____ f.	A layer of bricks, blocks, or stones in a masonry wall	6. Corner lead

2. List three types of masonry joints.

- a.
- b.
- c.

3. Select the correct types of masonry joint finishes below. Place a "✓" in the blank beside the correct types.

- _____ a. Flush
- _____ b. Concave
- _____ c. "A" groove
- _____ d. "V" groove
- _____ e. Raked

4. Identify the brick positions. Select the correct name for each from the list below and write it in the blank.

Stretcher

Sailor

Header

Rowlock

Soldier

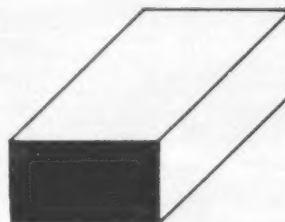
Rowlock stretcher



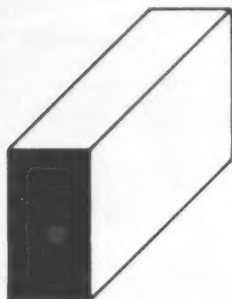
a. _____



b. _____



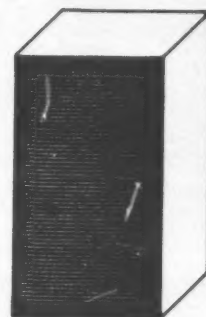
c. _____



d. _____



e. _____



f. _____

5. Identify the kinds of brick courses below. Place a "✓" in the blank beside the correct kinds.

_____ a. Stretcher

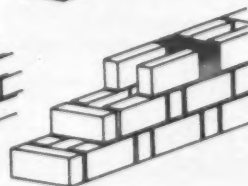
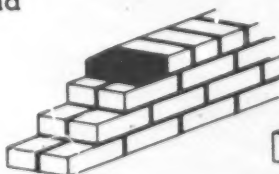
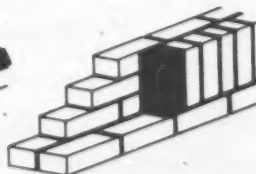
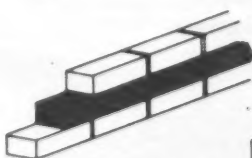
_____ b. Header

_____ c. Rowlock

_____ d. Mortar bond

_____ e. Soldier

_____ f. Box row



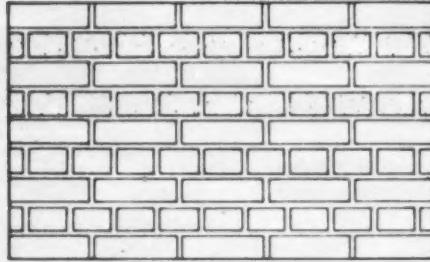
6. Identify the brick bonds. Select the correct name. the list below and write it in the blank.

American

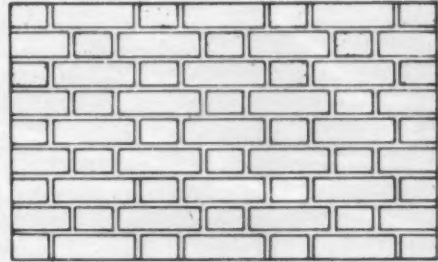
English

Flemish

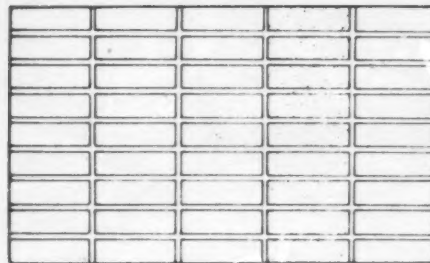
Stack



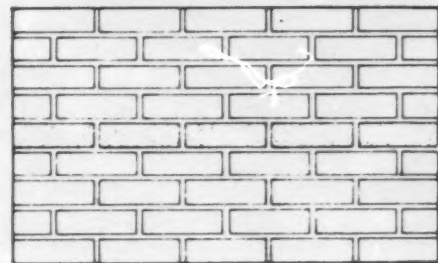
a. _____



b. _____



c. _____



d. _____

7. List two types of concrete block bonds.

a.

b.

8. Select the correct statements below about corner lead. Place a "✓" in the blank.

_____ a. The corner pole is plumbed after it is set in place

_____ b. Corners are always laid last

- ☐ c. The stretcher course is laid without mortar to check spacing
 - ☐ d. Check for plumb and level as corner is laid
9. Select the correct statements below about masonry wall opening. Place a "/" in the blank.
- ☐ a. Location of openings must be established
 - ☐ b. Size and height of opening is not important
 - ☐ c. Sheetrock is used for lintels
10. Demonstrate the ability to:
- a. Lay a corner lead six courses high
 - b. Complete a wall between corner leads

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

UNIT V
MASONRY WALLS

ANSWERS TO UNIT TEST

1. 6 a.
3 b.
1 c.
4 d.
2 e.
5 f.
2. a. Bed
b. Head
c. Closure
3. ✓ a.
✓ b.
 c.
✓ d.
✓ e.
4. a. Soldier
b. Rowlock stretcher
c. Header
d. Rowlock
e. Stretcher
f. Sailor
5. ✓ a. d.
✓ b. ✓ e.
✓ c. f.

6. a. English
 b. Flemish
 c. Stack
 d. American
7. a. Straight
 b. Decorative
8. ✓ a.
 b.
 ✓ c.
 ✓ d.
9. ✓ a.
 b.
 c.
10. (a-b). Evaluated to the satisfaction of the instructor.